Lillooet Timber Supply Area
Timber Supply Review #3

Analysis Report

Version 1.0

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Prepared For:

B.C. Ministry of Forests
Forest Analysis Branch
Victoria, BC

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More Information on the Timber Supply Review Process

This document was prepared to support an allowable annual cut determination by British Columbia's Chief Forester. To learn more about this process please visit the following website:

http://www.for.gov.bc.ca/hts/

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Comments and Questions

Input from First Nations and public is an important part of the Timber Supply Review process and you are encouraged to review the information in this document and forward any comments to Bruce Walter, RPF at the Ministry of Forests Cascades Forest District by **August 8, 2005**.

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Additional copies of this document are available on the web at http://www.for.gov.bc.ca/hts/tsa/tsa15/docs.htm.

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Finally, we thank and acknowledge Derek De Biasio of Crane Management Consultants Ltd for the completion the socio-economic analysis included in this document.

Executive Summary

This document contains a timber supply analysis and socio-economic analysis specific to the Lillooet Timber Supply Area (TSA). These analyses are an important part of the provincial Timber Supply Review (TSR) process. The purpose of the review is to examine the short- and long-term effects of current forest management practices on the availability of timber for harvesting in the TSA. A review of this type is completed at least once every five years in order to capture changes in data, practices, policy, or legislation influencing forest management in the TSA. The previous timber supply review (TSR2) was completed in January 2001 with a final Annual Allowable Cut (AAC) determination on January 1, 2002. This current review (TSR3) is working toward a new AAC determination to be in place before January 1, 2007.

The current allowable annual cut (AAC) for the Lillooet TSA is 635,900 m3/yr and contains no partitions. This analysis does not include any contribution of volume or area from Pulpwood Agreement 16 as there has been no demonstrated use to date. This AAC volume is currently allocated to Ainsworth Lumber Co. Ltd, Teal Cedar Ltd, Lytton Lumber Ltd, BC Timber Sales (BCTS), and several smaller operators.

The TSR3 Data Package, a document providing detailed technical information and assumptions regarding current forest management practices, policy and legislation for use in this analysis, was released in March 2004. The release of this Analysis Report is the next step in the TSR3 process. Its purpose is to summarize the results of the timber supply analysis and provide a focus for public discussion. The contents of this report will provide British Columbia's Chief Forester with a large portion of the information that is needed to make an informed AAC determination.

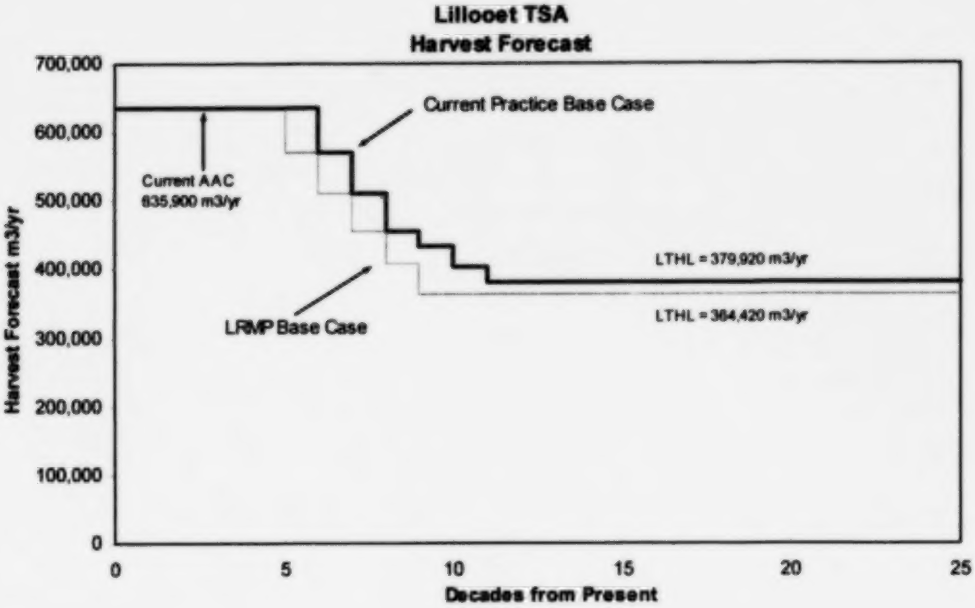
This report focuses on two forest management scenarios; one that reflects current management practices in the Lillooet TSA and one that reflects the July 2004 Draft Lillooet Land and Resource Management Plan (LRMP) assumptions.

The Lillooet TSA covers approximately 1.12 million hectares in the southern interior of British Columbia. The portion of this area considered available for timber production and harvesting under current management practices is called the timber harvesting land base (THLB). The THLB has been estimated through the analysis of spatial map layers and assumptions detailed in the Data Package (Appendix B). The result is a description of the area that is available for timber harvesting under TSA administrative structures. Based on these inputs, the THLB is estimated to be 250,426 ha, a decrease of 15% since the last timber supply review. The main factors behind this reduction are the exclusion of pulpwood agreement 16 stands and the Spruce Lake Protected Area from the TSR3 THLB.

Since the last timber supply review for the Lillooet TSA, many changes effecting forest management and timber supply projections have occurred. The major changes reflected in the current practice base case are as follows:

- Initial growing stock is significantly increased as a result of the VRI Phase 2 inventory adjustment. Long term productivity levels are also improved as a byproduct of the inventory adjustment (ht/age adjustments).
- Spotted owl long term activity centers are now part of management considerations in the TSA.
- Additional area (~2700 ha) is modeled under community watershed constraints.
- Volume gains associated with the use of select seed is modeled in managed stand yield curves (0.7% gain for Pl, 8.0% gain for Sx). No such gains were modeled in TSR2.
- Spatially explicit OGMA's are implemented instead of broad seral constraints based on provincial 45/45/10 weighted average biodiversity emphasis.

This report presents a harvest flow with a stable short-term timber supply under both the current practice and LRMP base case scenarios. The current practice scenario shows the current AAC (635,900 m^3/yr) being maintained for 6 decades before declining 40% to a long-term harvest level of 379,920 m^3/yr. The LRMP scenario shows the current AAC being maintained for 5 decades and then declining 43% to a long term level of 364,420 m3/yr. The major causes of the reduced harvest projection in the LRMP scenario are the addition of new parks, working land base reductions associated with grizzly bear, and to a lesser degree, cover constraints associated with mule deer winter range.



In order to assess the impacts of potential changes to modeling assumptions, and gain further understanding of the dynamics at work in the base case forecasts, a series of sensitivity analyses were completed.

Uncertainties that altered the harvest level in the short-term (next 20 yrs) were:

- Radical changes in economic assumptions (i.e. assume no occurrence of high market conditions).

Uncertainties that altered the long-term harvest level by at least 3% were:

- Changes to the size of the timber harvesting land base,
- Changes to natural or managed stand yields,
- Reductions in the length of time it takes regenerated stands to green-up,
- Management guidelines for grizzly bear habitat,
- Increase in managed stands site productivity estimates (SIBEC), and
- Allowing old seral retention to shift on the land base over time (non spatial OGMAs).

Although these sensitivities indicate that there is potential for the harvest forecast to change, the current practice base case scenario is felt to best represent the current situation in the Lillooet TSA until final approval is given to the Draft LRMP document.

A socio-economic assessment of the importance of the forest industry to the Lillooet TSA and the province was also completed. Based on facts and data collected, it was concluded that the base case harvest forecast of 635,900 m^3 (which extends for six decades) could annually support the following.

- estimated 948 PYs of total employment and $39.6 million of employment income in the Lillooet TSA;
- estimated 1 600 PYs of total employment and $62.0 million of employment income in the province;
- estimated $11.9 million of stumpage and $28.1 million of total BC Government revenues.

Since the base case harvest forecast and the current AAC are the same for several decades there will be neither positive nor negative impacts for the regional economy unless the AAC stability contributes to decisions about capital investments in processing capability.

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1.0 Introduction

Timber supply is the amount of timber available for harvest over time. Assessing timber supply involves consideration of a wide range of physical, biological, social, and economic factors that can influence the acceptable rate of timber harvesting within a management unit. These factors encompass both the timber and non-timber values found in our forests and ensure that timber harvesting objectives are balanced against concerns for wildlife, biodiversity, watershed health, recreational opportunities, etc.

This document contains a timber supply analysis and socio-economic analysis specific to the Lillooet Timber Supply Area (TSA). These analyses are an important part of the provincial Timber Supply Review (TSR) process. The general objective of the TSR process is to examine the short- and long-term effects of current forest management practices on the availability of timber for harvesting in the TSA. A review of this type is completed at least once every five years in order to capture changes in data, practices, policy, or legislation influencing forest management in the TSA. The previous timber supply review (TSR2) was completed in January 2001 with a final Annual Allowable Cut (AAC) determination on January 1, 2002. This current review (TSR3) is working toward a new AAC determination to be in place before January 1, 2007.

The Data Package, a document providing detailed technical information and assumptions regarding current forest management practices, policy and legislation for use in this analysis, was released in March 2004. The release of this Analysis Report is the next step in the TSR3 process. Its purpose is to summarize the results of the timber supply analysis and provide a focus for public discussion. The contents of this report will provide the British Columbia's Chief Forester with only a portion of the information that is needed to make an informed AAC determination. **This report does not define a new AAC – it is intended only to provide insight into the likely future timber supply of the Lillooet TSA and recommend a future course of action to the Chief Forester.** The final harvest level decision will be made by the Chief Forester and published along with his rationale in an AAC Determination document.

This report focuses on a single forest management scenario that reflects current management practices in the TSA. In addition to this current management or "base case" scenario, an LRMP scenario is examined. An assessment of how results might be affected by uncertainties has also been completed using a number of sensitivity analyses and critical issue analyses. Together, these analyses and the base case form a solid foundation for discussions among stakeholders about appropriate timber harvesting levels in the Lillooet TSA.

1.1 Background

The Ministry of Forests (MOF) is currently implementing a policy framework that establishes obligations and opportunities for collaborative forest management within the province's 37 timber supply areas (TSA). This framework is commonly referred to as the Defined Forest Area Management (DFAM) initiative. Under DFAM, specified licensees and BC Timber Sales (BCTS) can assume a collective responsibility for timber supply analysis within each timber supply area. In this case, the licensees of the Lillooet TSA chose not to assume this responsibility and left the analysis to the MOF to complete.

Under contract to the MOF, Timberline Forest Inventory Consultants prepared the Data Package released for public and First Nations review in March 2004. Forsite was then awarded the contract to update the Data Package, complete the analysis, and compile this report. The Data Package provided in Appendix B reflects the final inputs and assumptions used during modeling.

2.0 Description of the Lillooet Timber Supply Area

Located in Southwestern British Columbia between the Coast Mountains and the Thompson-Okanagan Plateau, the Lillooet TSA is comprised of approximately 1 125 000 hectares of the British Columbia Forest Service's Cascades Forest District.

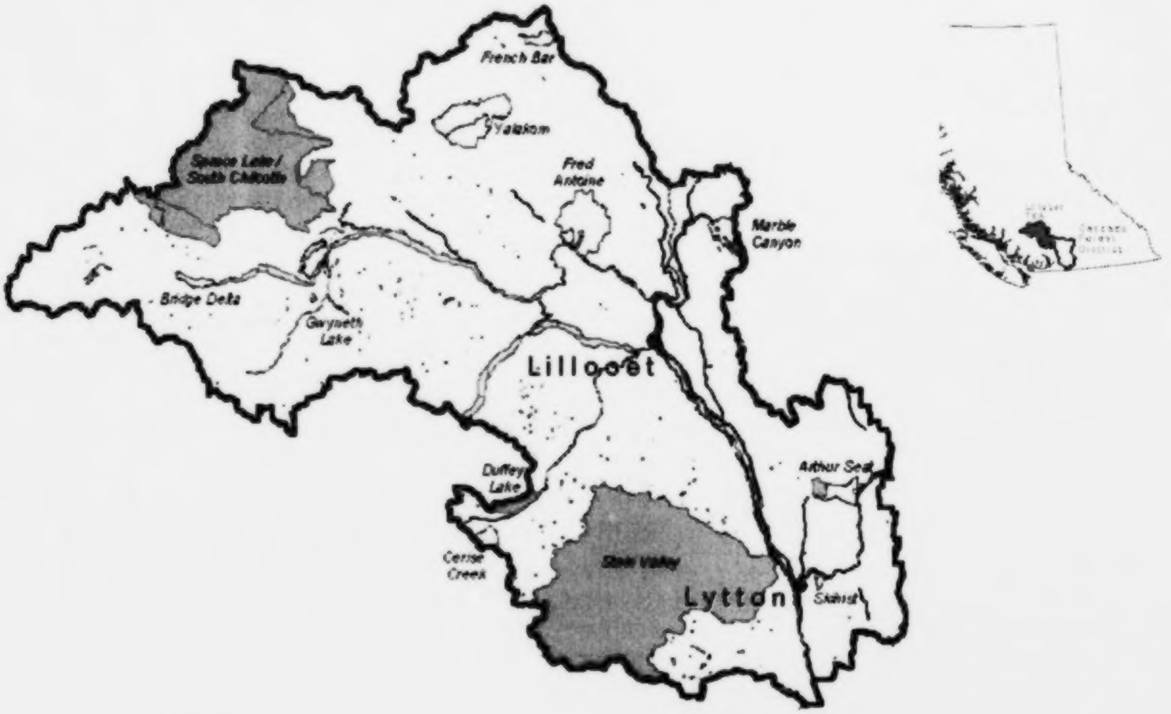

Figure 1. Lillooet Timber Supply Area

The Lillooet TSA is characterized by rugged topography and dramatic climatic variations resulting from the mountainous terrain found in this region. In the western portion of the TSA, temperate rain forest conditions persist, while the eastern portion is dominated by the dry grasslands and semi-arid landscapes that comprise the interior dry belt.

The diverse climate of the Lillooet TSA results in a wide variety of tree species. Lodgepole pine, Douglas-fir and spruce dominate, but other species are also present including: ponderosa pine, whitebark pine, subalpine fir (balsam), western redcedar and hemlock.

Lillooet is the largest community in the TSA with a population equal to approximately one-third of the entire population for this region. Several smaller communities and First Nations reserves occur within the TSA including: Seton Portage, Shalalth, Xaxli'p, Lytton, Pavillion, Spences Bridge, Bralorne, and Gold Bridge.

The Lillooet TSA currently includes several provincial parks and protected areas, such as the Stein Valley Nlaka'Pamux Heritage Park, Spruce Lake Protected Area (South Chilcotin), Duffy Lake Park, Skwaha Lake Park, Marble Canyon Park, Skihist Park and Goldpan Park. Recreation opportunities are significant and include activities such as mountain biking, hiking, climbing, fishing, camping, wildlife viewing, whitewater boating, heli-skiing, snowmobiling, ski mountaineering, cross country skiing, and downhill skiing. The TSA also contains significant water resources including several community watersheds (19 in total) which are the primary source of drinking water for the communities in this area.

A wide variety of wildlife species inhabit the diverse stands of the Lillooet TSA. Ungulate species include elk, mule deer, moose, bighorn sheep, and mountain goat. Other large mammals include grizzly bear and black bear, while small mammals and birds are also abundant throughout the TSA. Small furbearers include beaver, mink, muskrat, otter, fisher, marten, skunk, weasel, badger, wolverine, bobcat, lynx, squirrel, fox, and raccoon.

The lakes and streams of the TSA provide valuable bird habitat while supporting a wide range of fish species, including bull trout, rainbow trout, kokanee, pink salmon, coho, sockeye, steelhead, Chinook, whitefish and white sturgeon.

There are wildlife species in the TSA which are at risk due to declining populations across the province. There are 10 red-listed (Endangered or Threatened) and 23 blue-listed (Species of Concern) species found in the Lillooet TSA (Table 1).

Table 1 . Red and Blue Listed Species with Potential to Occur in TSA

Red-listed (Endangered or Threatened)		**Blue-listed (Species of Concern)**	
Scientific Name	**English Name**	**Scientific Name**	**English Name**
Acipenser transmontanus pop. 4	White Sturgeon (Lower Fraser River population)	*Aeronautes saxatalis*	White-throated Swift
Antrozous pallidus	Pallid Bat	*Ardea herodias herodias*	Great Blue heron, *herodias* subspecies
Buteo swainsoni	Swainson's Hawk	*Ascaphus truei*	Coastal Tailed Frog
Falco mexicanus	Prairie Falcon	*Asio flammeus*	Short-eared Owl
Limenitis archippus	Viceroy	*Botaurus lentiginosus*	American Bittern
Martes pennanti	Fisher	*Colias occidentalis*	Western Sulphur
Otus kennicottii macfarlanei	Western Screech-Owl, *macfarlanei* subspecies	*Coluber constrictor*	Racer
Spizella breweri breweri	Brewer's Sparrow, *breweri* subspecies	*Crotalus oreganus*	Western Rattlesnake
Strix occidentalis	Spotted Owl	*Danaus plexippus*	Monarch
Taxidea taxus	Badger	*Euderma maculatum*	Spotted Bat
		Euphyes vestris	Dun Skipper
		Gulo gulo luscus	Wolverine, *luscus* subspecies
		Melanerpes lewis	Lewis's Woodpecker
		Myotis ciliolabrum	Western Small-footed Myotis
		Myotis thysanodes	Fringed Myotis
		Numenius americanus	Long-billed Curlew
		Oncorhynchus clarki clarki	Cutthroat Trout, *clarki* subspecies
		Otus flammeolus	Flammulated Owl
		Pituophis catenifer deserticola	Gopher Snake, *deserticola* subspecies
		Salvelinus confluentus	Bull Trout
		Salvelinus malma	Dolly Varden
		Sphyrapicus thyroideus thyroideus	Williamson's Sapsucker, *thyroideus* subspecies
		Ursus arctos	Grizzly Bear

Source: Conservation Data Center database query, March 2005.

2.1 First Nations

A large First Nations population is present in the TSA and is comprised of four broad cultural groups: St'at'imc, Nlaka'pamux, Secwepemc and Tsilhqot'in. These groups have traditional territory within the TSA, and archaeological evidence suggests that they have inhabited the Lillooet region since the last glaciation over 10,000 years ago.

The St'at'imc, Nlaka'pamux, Secwepemc and Tsilhqot'in people are further subdivided into twenty-eight First Nations communities, twelve of which reside within the TSA. The remaining sixteen communities are located outside the Lillooet TSA but also use the area for sustenance, cultural and spiritual activities.

Both Traditional Use mapping and Archeology Overview Assessment mapping have been completed in the Lillooet TSA and are being used to help protect cultural resources. In addition, a number of Archaeological Impact Assessments have been completed to identify sites of archaeological significance and develop strategies to protect them.

The Nlaka'pamux, St'at'imc, Secwepemc, and Tsilhqot'in First Nations are represented by eight tribal associations who are responsible for strategic planning, economic development and coordination of information regarding the lands traditionally claimed by the First Nations in this area. However, during the development of the Lillooet Land and Resource Management Plan (LRMP), input from the tribal associations was limited and to date no First Nations group has endorsed the plan. Consultation on the July 2004 draft of the LMRP is now ongoing.

Some government-to-government protocol agreements and letters of understanding have been signed. These will help First Nations engage in reviewing and implementing the LRMP. A key agreement is the Government-to-Government protocol between the Province and the St'at'imc Chiefs' Council signed June 7, 2004.

Forest and Range Agreements (FRA) are negotiated interim measures agreements between the Ministry of Forests and a First Nation. Through these agreements the Ministry of Forests seeks to accommodate the economic aspect of First Nation's potential aboriginal title interests and to negotiate provisions to facilitate consultation on operational planning and administrative decisions. The Bonaparte Indian Band, with interests in the northeast corner of the Lillooet TSA, currently has a FRA with the Ministry of Forests.

It is recognized that ongoing treaty negotiations with First Nations have the potential to impact timber supply in the TSA. However, "current management" was the underlying assumption for the analysis and no settlement has yet been reached. The final results from treaty negotiations will be modeled in subsequent timber supply reviews when this information becomes available.

2.2 The Environment

The Lillooet TSA contains seven biogeoclimatic zones that range from dry grasslands at lower elevations to coniferous forests at middle elevations, and alpine tundra at higher elevations. These seven zones are further subdivided into 51 variants, giving further indication of the climatic and biological diversity in this area. Refer to Figure 2 for an area breakdown by biogeoclimatic zone and natural disturbance type. Detail on the 51 BEC variants can be found in Appendix C.

The Ponderosa Pine (PP) zone occurs at low elevations of the very dry valley bottoms along the Fraser and Thompson rivers. This zone is characterized by low annual precipitation, very warm summers, and cool winters. Open, park-like stands of ponderosa pine with grasses in the understory tend to dominate this zone making it of limited value for commercial forestry. However, it is important for cattle grazing, particularly in the early spring and late fall.

The Interior Douglas-fir (IDF) zone typically occurs between the Ponderosa Pine Zone and the Montane Spruce zone. The IDF is characterized by warm, dry summers, a fairly long growing season and cool winters. Moisture deficits are common during the growing season. Douglas-fir is the dominant tree species in this zone, while ponderosa pine occur at lower elevations; spruce at higher elevations, and lodgepole pine throughout. A large portion of the timber harvesting land base in the Lillooet TSA occurs in this zone.

The Coastal Western Hemlock (CWH) zone occurs at low to middle elevations along the slopes of the Coast Mountains and has a minor presence in the Lillooet TSA. It is the wettest zone in the province, with cool summers and mild winters. The dominant tree species are western hemlock and western red cedar.The Montane Spruce (MS) zone is found at mid-elevations, often between the Interior Douglas-fir Zone and the Engelmann Spruce-Subalpine Fir Zone. This zone is characterized by cold winters and moderately short, warm summers. Although subalpine fir and spruce are the climax tree species, one of the most distinctive features of this zone is the extensive even-aged stands of lodgepole pine that have formed following relatively frequent wildfire. Other common species found in this zone are Douglas-fir, western red cedar, trembling aspen and cottonwood.

The Engelmann Spruce-Subalpine Fir (ESSF) zone is the uppermost forested zone, lying below the Alpine Tundra zone. Growing seasons are cool and short while winters are long and cold. Forests are continuous at the lower elevations of this zone, but at higher elevations clumps of trees occur within areas of heath, meadow and grassland. Engelmann spruce and subalpine fir are the dominant climax tree species, while lodepole pine is common after fires. At lower elevations of this zone, western white pine, Douglas-fir, western hemlock and western red cedar can also be found.

The Alpine Tundra Zone lies above the Engelmann Spruce-Subalpine Fir Zone, and is by definition treeless although stunted (or krummholz) trees are common at the lower elevations of this zone. Overall, this zone is dominated by rock, ice and grassy meadows.

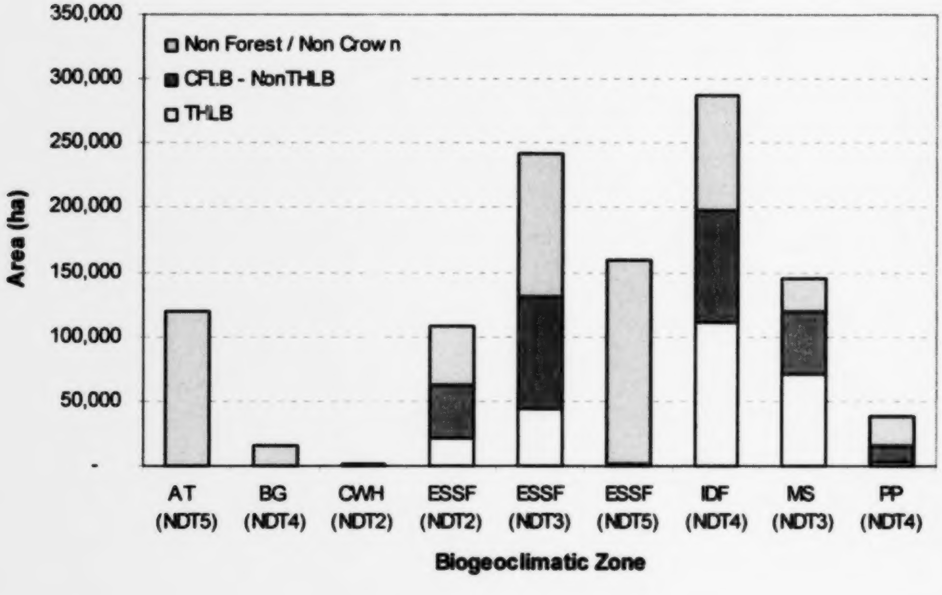

Figure 2. Biogeoclimatic Ecosystem Classification within the Lillooet TSA

2.3 Integrated Resource Management Considerations

Integrated resource management is the basic premise for the practice of forestry in the Lillooet TSA. Timber harvesting is planned and managed is such a way that allows a wide range of other values to co-exist on the land base. The manner in which each value is considered is dictated by federal or provincial legislation or BC government policy. Examples of these are the federal Fisheries Act, the Forest Practices Code / Forest and Range Practices Act, and several Cascades Forest District Policies.

These documents address requirements for a wide range of non-timber issues. The most significant issues influencing forest management in the Lillooet TSA are:

- First Nations considerations
- Biodiversity
- Riparian Habitat
- Community Watersheds
- Ungulate Winter Range (Mule Deer, Elk, Moose, Bighorn Sheep, Mountain Goats)
- Grizzly Bear
- Identified Wildlife
- Viewscapes in Scenic Corridors
- Forest Recreation

The areas affected by each of these non-timber resource values and the specific forest management practices required to address them are discussed in Section 3.3.1.

2.4 Current Attributes of the Lillooet TSA

This section of the document describes the current state of the Lillooet TSA and provides descriptions and statistics useful for understanding the timber supply analyses presented later in the document. The Timber Harvesting Land Base (THLB) and Crown Forested Land Base (CFLB) referenced in this section are defined in detail in Section 3.1.

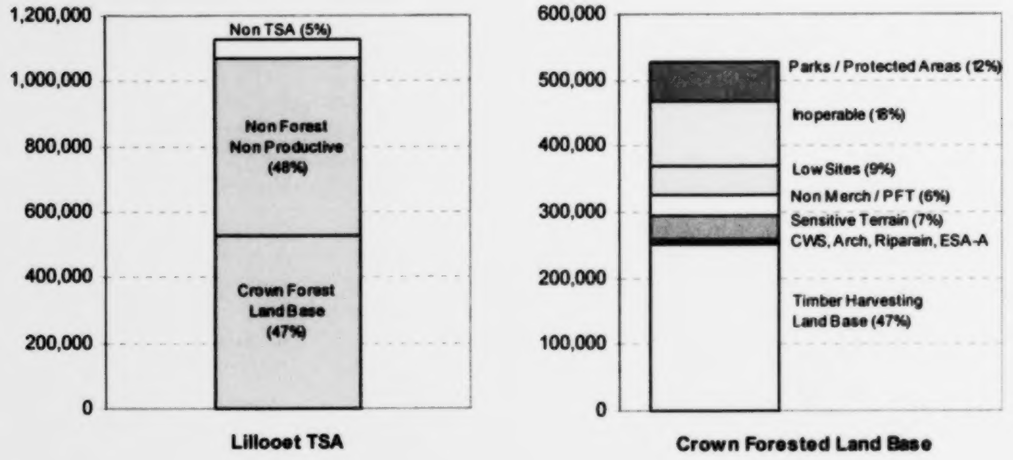

Figure 3. Land Base Summary: Total and CFLB

Approximately 47% of the total area of the Lillooet TSA is considered Crown Forested Land Base (CFLB). The remaining 53% is considered non-productive (i.e. rock, ice, alpine, etc), or is not managed by the B.C. Forest Service (i.e. private, First Nations, woodlots, etc). Within the CFLB, only about 47% is considered available for timber harvesting (22% of the total TSA). Refer to Figure 3.

A coarse map illustrating the locations of the CFLB and THLB is provided in Figure 4.

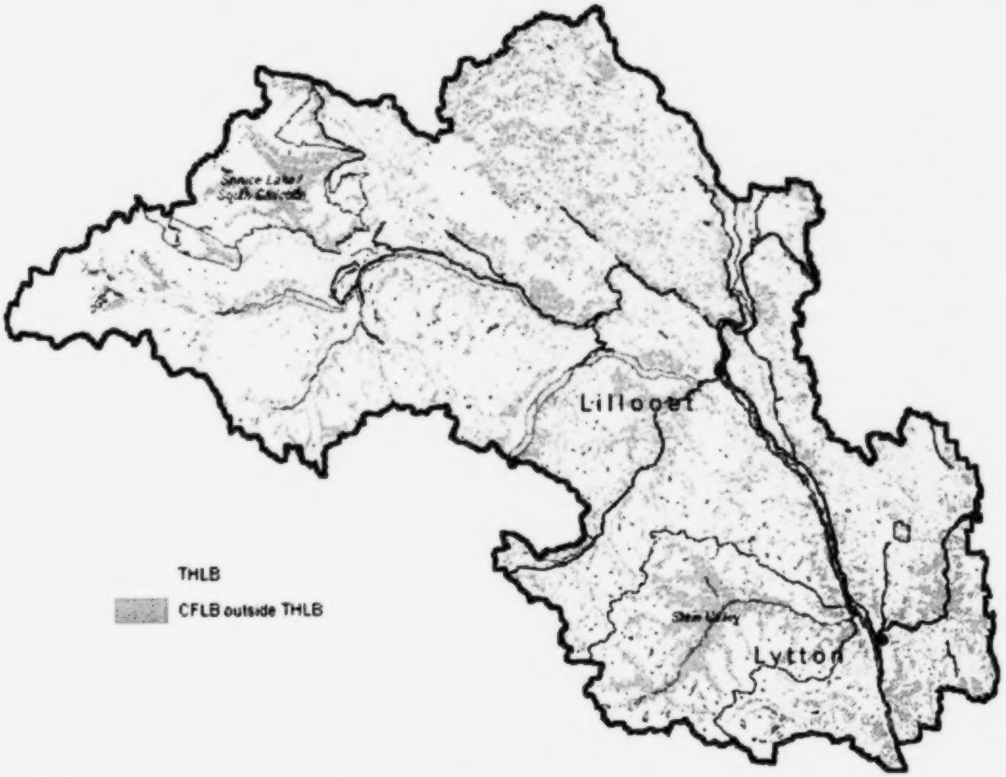

Figure 4. Land base classification map - current practice THLB

The forests of the Lillooet TSA are dominated by Douglas-fir (41%), lodgepole pine (39%), and spruce/balsam (19%) stands (Figure 5). Other tree species that occur less commonly in the TSA include ponderosa pine, western hemlock, whitebark pine, and several deciduous species. Figure 5 indicates that approximately 70% of the THLB is currently older than the minimum harvest ages defined in this document.

Figure 6 indicates that over 74% of the THLB is currently older than 80 years of age and that Douglas-fir tend to make up a large component of the older age classes.

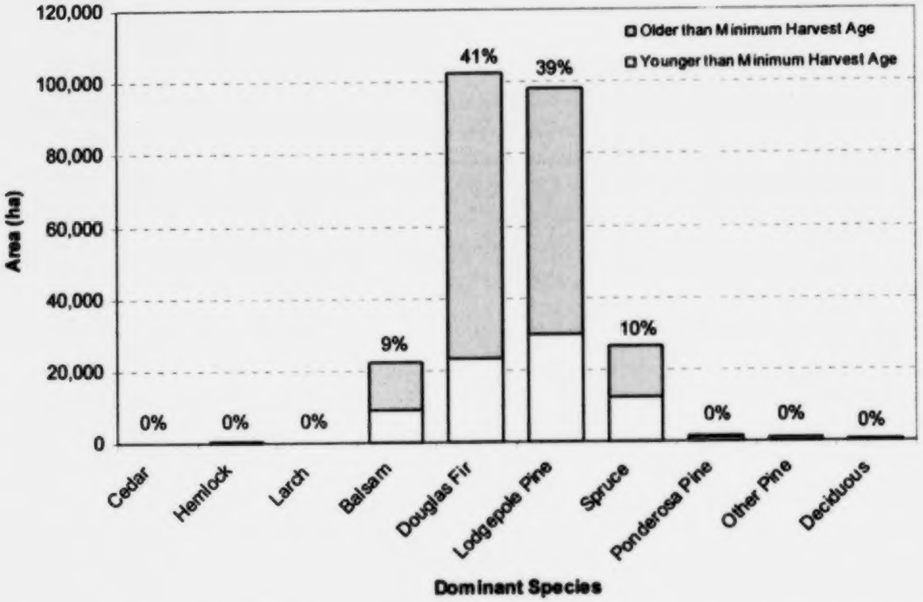

Figure 5. THLB area by dominant tree species relative to minimum harvest age (Current Practice)

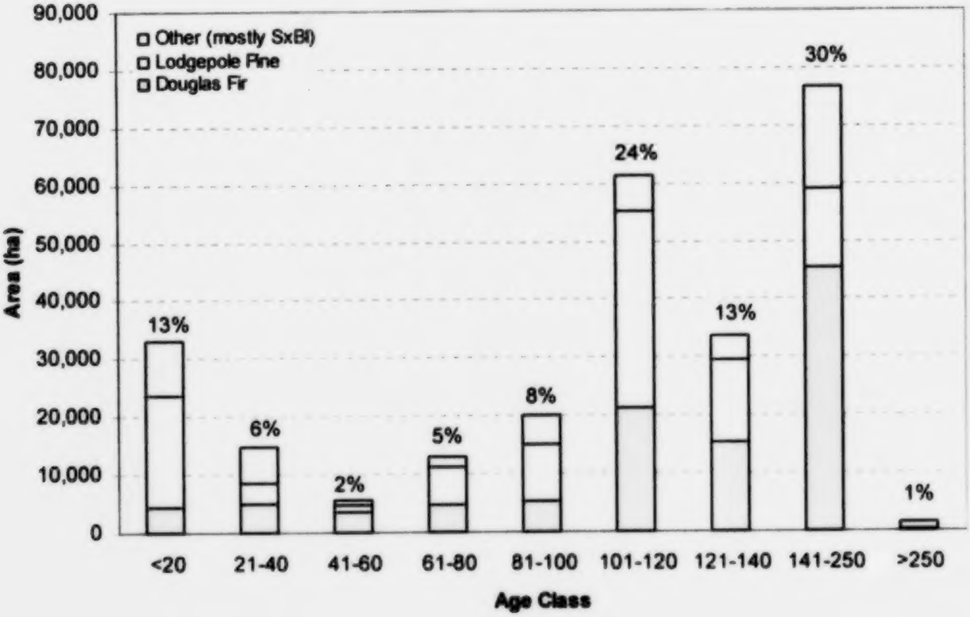

Figure 6. THLB area by age class and leading species (Current Practice)

The age class structure over the entire CFLB is shown in Figure 7. Area is well distributed over a wide range of age classes, with most area (70%) falling within the 60-160 year age classes. The younger age classes (<30 yrs) have a high % of THLB within them because the predominate method of creating young stands in recent years has been forest harvesting.

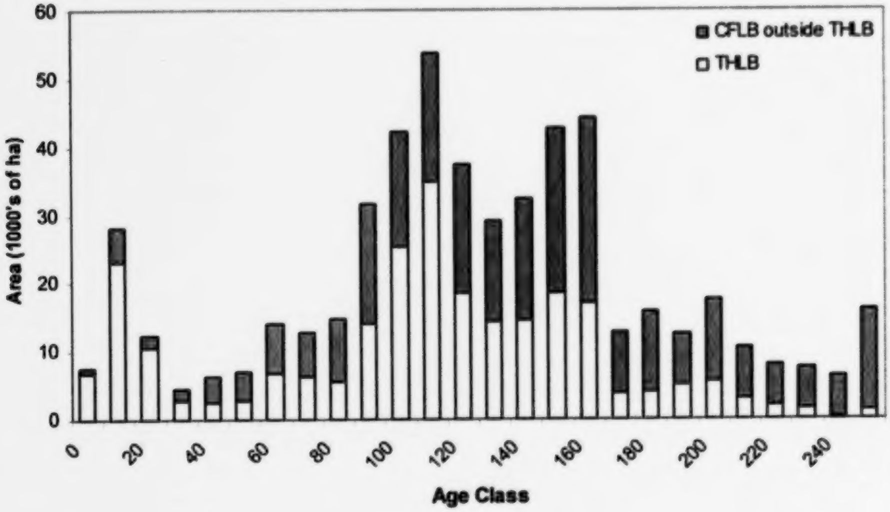

Figure 7 . CFLB area by Age Class

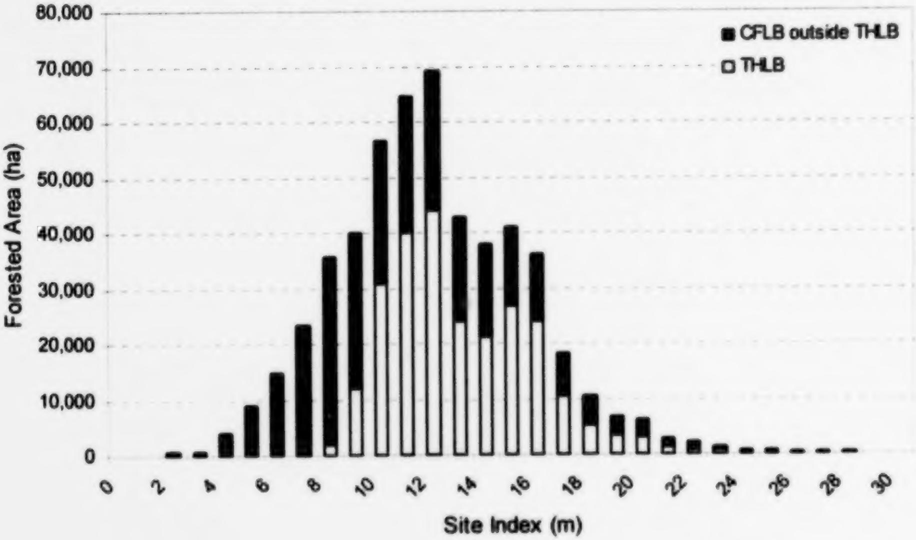

Figure 8 . Site Productivity by Landbase Type (VRI Adjusted SI's – Current THLB)

A summary of area by site productivity as indicated by adjusted inventory estimates is shown in Figure 8 and indicates that the THLB area is heavily skewed toward the portion of the land base with higher site indexes. As per the low site index netdown criteria listed in Appendix B, no THLB area occurs where site index is less than 8 and only small portions of site indexes 8-9 are included in the THLB. The average site index in the THLB is 13.1 metres.

The average site index for all future managed stands on the THLB was calculated as 14.8m using the SIBEC site index adjustment process (see Appendix B – Section 4.1.2). This is 1.7m or 13% higher than the current adjusted inventory estimate. The SIBEC derived site index values were only used in the SIBEC critical issue analysis.

3.0 Timber Supply Analysis Methods

A large amount of information is required to complete a timber supply analysis. Information must be obtained in four broad categories: land base, forest inventory, management practices, and forest dynamics. This information is then translated into a model formulation that can explore sustainable rates of harvest in the context of integrated resource management. This section summarizes the data inputs, assumptions, and modeling procedures contained in Appendix B.

3.1 Land Base Definition

The crown forested land base (CFLB) is the area of productive forest under provincial crown ownership. This portion of the land base contributes to forest management objectives, such as landscape-level biodiversity, wildlife habitat and visual quality. The crown forested land base excludes non-crown land, non TSA lands, and non-forest / non-productive areas. It also does not include alpine forest or non-productive areas with trees species.

The timber harvesting land base (THLB) is the portion of the management unit where forest licensees under licence to the province of BC are expected to be able to harvest timber. The THLB is a subset of the crown forested land base and excludes areas that are inoperable or uneconomic for timber harvesting, or are otherwise off-limits to timber harvesting. Table 2 summarizes the land base for the Lillooet TSA. A more detailed description of netdown areas can be found in Appendix B, Section 2.0.

Table 2. Land Base Area Netdown Summary

	Current Practice Base Case			LRMP Base Case		
Land Base Element	**Effective* Area (ha)**	**% Total**	**% CFLB**	**Effective* Area (ha)**	**% Total**	**% CFLB**
Total area (Lillooet Forest District)	1,124,999	100%		1,124,999	100%	
Less:						
Private Land, First Nation reserves	46,539	4%		46,539	4%	
Woodlots, Misc Leases	9,800	1%		9,800	1%	
Total TSA Area	1,068,659	95%		1,068,659	95%	
Non forest / Non-productive forest	530,792	47%		530,792	47%	
Non-Commercial Brush	531	0%		531	0%	
Unclassified existing roads, trails and landings	9,240	1%		9,195	1%	
Total Crown Forested Land Base[**] (CFLB)	528,096	47%	100%	528,141	47%	100%
Less:						
Parks and Ecological Reserves	60,945	5%	12%	76,963	7%	15%
Inoperable/Inaccessible	96,045	9%	18%	94,414	8%	18%
Unstable / Sensitive Terrain	34,899	3%	7%	33,084	3%	6%
ESA - Avalanche	735	0%	0%	710	0%	0%
Non-Merchantable or Problem Types	31,281	3%	6%	29,111	3%	6%
Low Sites	45,387	4%	9%	42,465	4%	8%
Riparian Management	7,557	1%	1%	7,414	1%	1%
Cultural Heritage	818	0%	0%	818	0%	0%
Community Watershed Intakes	3	0%	0%	3	0%	0%
Timber Harvesting Land Base –THLB (ha)	**250,426**	**22%**	**47%**	**243,160**	**22%**	**46%**
Volume Reductions:						
Future Wildlife Tree Patches (%)	14,525	1%	3%	14,103	1%	3%
Future roads, trails and landings	10,231	1%	2%	9,757	1%	2%
Long Term Timber Harvesting Land Base (ha)	225,670	20%	43%	219,301	19%	42%

* Effective netdown areas represent the area that was actually removed as a result of a given factor. Removals are applied in the order shown above, thus areas removed lower on the list do not contain areas that overlap with factors that occur higher on the list. For example, the unstable terrain netdown only removes area from the crown, operable forested land base.

3.2 Forest Inventory Data

Understanding and representing the current state of the forests in the TSA is a key component of the timber supply review. The digital forest cover inventory files provide this data (species, age, height, site productivity, etc). A history of the Lillooet forest cover data is summarized briefly below:

- The forest cover inventory for the Lillooet TSA was completed in four separate re-inventory projects between 1988 and 1990. The present forest cover inventory is updated to Nov 2002 to account for changes in denudation through harvesting. All forest cover inventory information currently exists in VEG / FIP rollover status. The new harvesting recently integrated in the files was either in the INCOSADA format (i.e. attribute data included) or in the VRI format (i.e. no attribute data in files). 'Results' data linking on opening number was obtained from Tim Salkeld (MSRM Victoria) to fill in attribute information for those polygons with no data.
- An inventory adjustment process based on VRI Phase 2 ground plots was completed by MoF/MSRM in 2004. Ages and heights were adjusted according to sampling results and then site indexes were recalculated. A final volume adjustment was then determined using stand volumes projected using the updated site index information. More detail on how this was applied using modeling can be found in Appendix B, Section 3.10.1.
- Forest cover attributes were projected to January 1, 2004 by MSRM prior to this project. Projected volumes incorporated the full inventory adjustment.

3.3 Management Practices

Management practice assumptions can be grouped into three broad categories: Integrated Resource Management, Silviculture, and Harvesting.

3.3.1 Integrated Resource Management

In order to accommodate the range of timber and non-timber resource objectives that occur within the TSA, forest cover requirements were applied within the timber supply model. These requirements limit disturbance or maintain appropriate levels of specific forest types that are needed to satisfy objectives for wildlife habitat, visual quality, biological diversity, etc. A summary of the areas over which various non-timber resource values occur is provided in Table 3 (Current Practice) and Table 4 (LRMP). The specific forest cover requirements modeled for each objective are provided in Appendix B – Section 7.0.

Areas in Table 3 and Table 4 cannot be summed to determine the total area affected because many of the values overlap on the land base. For the current base case, approximately 154,050 ha or 62% of the THLB falls outside of all non-timber resource constraints applied in the model (i.e. outside spatial OGMAs, CWS, VQO's, spotted owl LTAC's). For the LRMP base case, this value is 121,527 ha or 50%.

Table 3. Integrated Resource Values: Area Summary by Land Base Type (Current Practice)

Name	CFLB (ha)	% of CFLB	THLB	% of THLB	Description
Greenup	250,426	47%	250,426	100%	
Community Watersheds	39,465	7%	22,092	9%	Includes Twaal and Gun Watersheds
Spotted Owl LTAC's	16,710	3%	8,459	3%	
VQO - Retention	13,718	3%	2,651	1%	
VQO - Partial Retention	94,958	18%	46,633	19%	
VQO - Modification	32,726	6%	17,363	7%	
High BEO	70,505	14%	30,172	12%	Biodiversity Emphasis Options
Inter BEO	224,365	46%	111,050	44%	
Low BEO	195,301	40%	109,176	44%	
OGMA	70,602	14%	16,079	6%	Area of spatial OGMA

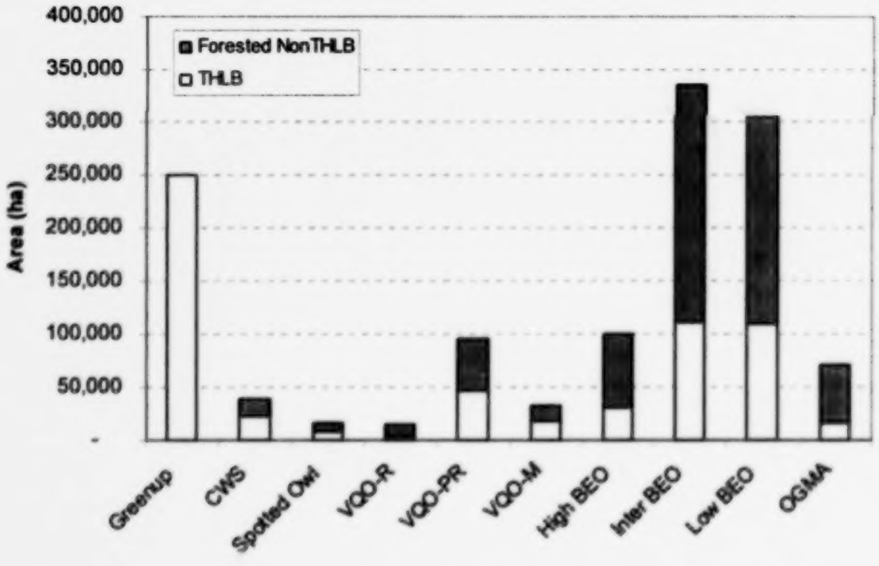

Figure 9. Integrated Resource Values: Area Summary by Land Base Type (Current Practice)

Table 4. Integrated Resource Values: Area Summary by Land Base Type (LRMP)

Name	CFLB (ha)	% of CFLB	THLB	% of THLB	Description
Greenup	243,160	46%	243,160	100%	
Community Watersheds	39,620	8%	22,061	9%	Includes Twaal and Gun Watersheds
Mule Deer Winter Range	125,135	24%	56,991	23%	
Elk	22,797	4%	10,162	4%	
Moose MMU	13,602	3%	8,474	3%	
Goat Escape Cover	9,294	2%	1,413	1%	
Grizzly Reserves	7,942	1%	7,942	3%	Grizzly no harvest areas
Spotted Owl LTAC's	16,808	3%	8,459	3%	
VQO - Retention	7,915	1%	1,623	1%	
VQO - Partial Retention	72,088	14%	33,838	14%	
VQO - Modification	19,074	4%	9,072	4%	
High BEO	72,011	15%	31,557	13%	
Inter BEO	227,912	46%	109,004	45%	Biodiversity Emphasis Options
Low BEO	199,487	41%	111,765	46%	
OGMA	58,086	14%	12,807	5%	Area of spatial OGMA

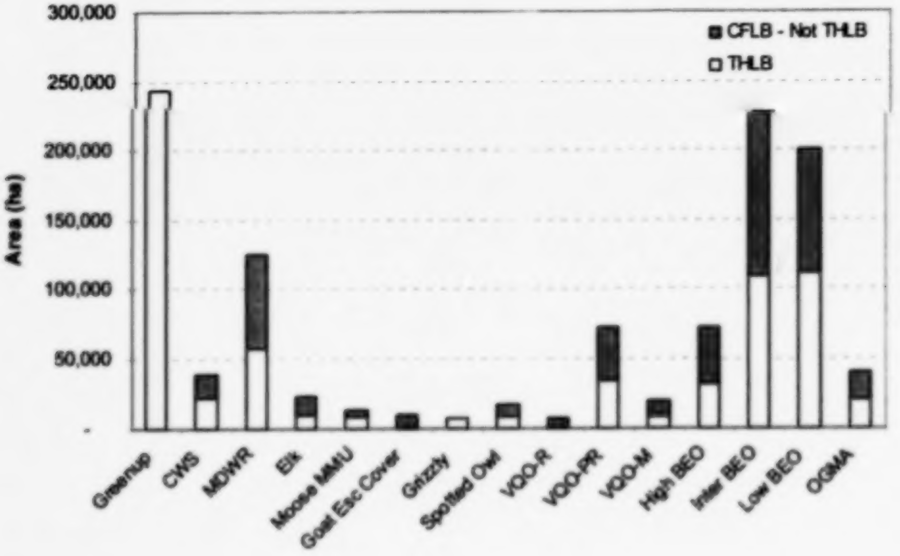

Figure 10. Integrated Resource Values: Area Summary by Land Base Type (LRMP Practice)

3.3.2 Silviculture

Historical and current silvicultural practices in the TSA have been included in the model. These include:

1. Silvicultural systems (clearcut vs partial cutting systems) [Appendix B Section 4.1]
2. Regeneration assumptions such as establishment method (plant vs natural), species distribution, and establishment density [Appendix B Section 4.1]
3. Regeneration delay (time between harvesting and when the site becomes stocked with crop trees) [Appendix B Section 4.2]
4. Use of select seed and [Appendix B Section 4.4]
5. Treatment of Backlog and current Not Satisfactorily Restocked (NSR) stands. [Appendix B Section 4.6]

The silviculture assumptions used are almost entirely consistent with TSR2. Only the increased use of select seed and a slight variation in how drybelt fir selection systems were modeled are different. See Appendix B for details.

3.3.3 Timber Harvesting

Assumptions around timber harvesting practices have also been included in the model and include:

- Minimum harvest ages that ensure a viable log is produced and long term volume production is maximized. (Appendix B – Section 5.1)
- Harvest priorities across the land base. (Appendix B – Section 5.3)
- Land base definition criteria (unstable slopes, inoperable areas, low sites, etc.). These assumptions are outlined in detail in Appendix B- Section 2.0.
- Harvest activity in pulpwood agreements. (Appendix B – Section 5.5).

3.4 Forest Dynamics

Forest dynamics refers to the changing state of the forest through time. Changes occur as it ages or grows and when natural or human caused disturbances occur. The way in which the model addresses these issues is described below.

3.4.1 Growth and Yield Projections

Timber growth and yield refers to the prediction of the growth and development of forest stands over time and the associated volume yields that would occur with harvesting. For modeling purposes, stands of similar characteristics, growth rates, and management are grouped together into Analysis Units (AUs). Analysis Units are described in Appendix B – Section 3.1. The attributes of each AU are input into growth and yield models to predict gross and net volume per hectare at various stand ages. The estimate of net timber volume in a stand assumes a specific utilization level, or set of dimensions, that establishes the minimum tree and log sizes that are removed from a site. Utilization levels used in estimating timber volumes specify minimum diametres near the base and the top of a tree.

Two growth and yield models were used to estimate timber volumes for the Lillooet TSA analysis. The Variable Density Yield Prediction (VDYP) model supported by the Ministry of Sustainable Resource Management, Terrestrial Information Branch, was used for estimating timber volumes for all existing natural stands and all coniferous stands that will be harvested in the future by partial harvesting. The table interpolation program for stand yields (TIPSY), developed by the B.C. Forest Service, Research Branch was used to estimate timber volumes for both existing and future managed stands. Existing managed stands are those that are currently under 28 years of age. Future managed stands are stands that will regenerate after they are harvested by the model during the planning horizon (excluding partial cut stands).

Based on forest inventory estimates, the current timber inventory or growing stock on the timber harvesting land base is approximately 47 million cubic metres. Approximately 92% of this growing stock (43.5 million m^3) is currently merchantable (i.e. in stands older than their minimum harvest age).

3.4.2 Disturbances

The timber supply model disturbs stands in three ways. Harvesting is the most common method of disturbance in the model (clearcut or partial cutting) and occurs only within the timber harvesting land base. In order to recognize that natural disturbances are also occurring on the land base, the following are also modeled:

Natural disturbances in the timber harvesting land base:

Each year timber volume is damaged or killed on the THLB and not salvaged or accounted for by other factors. These losses are due to a number of factors that cause tree mortality, including insects, disease, blowdown, snowpress, wildfires, etc. In order to address losses from catastrophic natural events in the THLB, the model 'harvests' an extra volume of timber in each time period that is not counted toward harvest levels. Endemic pest losses are dealt with through factors applied in the growth and yield models. The annual unsalvaged loss applied in this analysis was 26,080 m^3/yr. See Appendix B- Section 6.1 for more detail.

Unsalvaged loss estimates address the loss of merchantable volume from mature stands. Losses associated with immature stands also impact the rate at which timber becomes available in the TSA but little data is available to estimate the extent or impact of these losses. These disturbances will be captured during periodic inventory updates and are therefore reflected in subsequent TSRs.

Natural disturbances outside the timber harvesting land base:

Because stands outside of the THLB contribute toward several forest cover objectives (i.e. landscape level biodiversity), it is important that the age class distributions in these stands are modeled to remain consistent with natural processes. By simulating natural disturbance in these stands, a natural age class distribution can be maintained in the model and a realistic contribution toward seral goals ensured. An area of 948 ha is disturbed each year in the analysis to prevent age classes in the NonTHLB from becoming unrealistically old during modeling. (Appendix B – Section 6.2).

3.5 Timber Supply Analysis Methods

Forest Planning Studio (FPS) version 6.0.2.0 was used to complete the timber supply analysis. FPS was developed by Dr. John Nelson at the University of British Columbia (UBC) and is a spatially explicit forest estate simulation model. All events in the model are directly linked to stand level polygons or harvest units and thus allow tracking of individual stand attributes and spatial relationships through time. Each polygon belongs to a specific stand type (Analysis Unit) and has attributes such as age, harvest system, and land base status (THLB or Non THLB). Results are typically aggregated for reporting at higher levels (i.e harvest flow for entire unit).

A wide range of constraints can be modeled on the land base: harvest exclusion, spatial adjacency/maximum cutblock size, maximum disturbance/young seral, minimum mature/old seral, and equivalent clearcut area (ECA) limits. Constraints are applied to groups of polygons (cliques) and harvest is restricted if a constraint is not satisfied. A single polygon can belong to many overlapping cliques and each of them must be satisfied in order to allow harvest of the polygon. Where a mature or old cover constraint is not met, harvesting may still occur if there are any eligible stands remaining after the oldest stands are reserved to meet the constraint.

Harvest is implemented using a set of priorities to queue stands for harvest. In each period, the model harvests the highest priority eligible stands until it reaches the harvest target or exhausts the list of opportunities. Harvest can be implemented in single years, multiple year periods or a combination of these. Where periods are used, the midpoint of the period is typically used as the point where harvest opportunity is evaluated because it is a good balance between the start of the period (pessimistic) and the end of the period (optimistic).

The purpose of this analysis is to examine both the short- and long-term timber harvesting opportunities in the Lillooet TSA. The dominant scenario presented in this report is the base case or current management scenario. Modeling was completed for 500 years for each scenario but only the first 250 years are presented in the report because the harvest level remains constant after that time.

The results of the analysis are an important part of the annual allowable cut determination process and aim to document future harvest flows that will not restrict future options in the TSA. **The results presented here do not define a new AAC – they are intended only to provide insight into the likely future timber supply of the Lillooet TSA.** The final harvest level decision will be made by the Chief Forester and published along with his rationale in an AAC Determination document.

3.6 Major Changes from Previous Timber Supply Review (TSR2)

Since the last timber supply review for the Lillooet TSA (TSR2), changes have occurred in input data sets and management assumptions. In summary, the major changes from TSR2 are:

- The size of the current practice timber harvesting land base is smaller by 15% (250,426 ha vs 295,802 ha in TSR2[1]). Comparisons with TSR2 area netdowns are difficult because a different netdown hierarchy was used and the treatment of PA16 is not entirely clear, but several key differences are discussed below:
    - Pulpwood agreement stands no longer contribute to the THLB. The TSR2 Analysis Report (Jan 2001) indicated that the inclusion of the pulpwood agreement area increased the THLB by

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[1] TSR2 value from the Chief Foresters AAC rationale document (pg 10).

  approximately 42,500 ha, while the pulpwood agreement sensitivity analysis done in this report adds 29,963 ha to the THLB (so with PA16, TSR3 THLB would have been 280,389). The exclusion of the PA16 stands are reflected as higher 'low site' and 'non merchantable stand' netdowns in TSR3.

  - Existing road losses are now explicitly (spatially) identified and removed from the land base contributing to timber supply. This issue was addressed as a volume netdown in TSR2.
  - Terrain mapping has been completed ~95% of the operable land base and it was used in place of ESA soils data, resulting in reduced terrain netdowns;
  - Ownership data was updated to reflect all existing woodlots (~2135 ha of WL's added);
  - Archaeological sites were explicitly identified, buffered, and removed.
  - Spruce Lake Order in Council (OIC) protected area is explicitly identified and removed from the land base contributing to timber supply. TSR2 did not remove it until a sensitivity analyses was completed and resulted in the loss of 11,641 ha of THLB.
  - Existing forest inventory age and height values were adjusted (*Lillooet Forest District VRI Statistical Adjustment Addendum, April 2003 + July 14/2004 spreadsheet*) and have implications on low site and non merchantable stand netdowns.
- Differences in input data and management assumptions in the current practice base case also occurred relative to TSR2:
  - Existing forest inventory volume estimates were adjusted to reflect VRI ground plot data. The adjustment produced an average volume increase of 12.4% across the THLB and resulted in a significant increase in existing growing stock on the land base. Managed stands volumes were also impacted because the adjustment also impacted site index values on many polygons resulting in a net increase in average SI.
  - Existing forest inventory has been updated for disturbance to 2002 and projected to Jan 2004;
  - TSR3 modeled the use of select seed for Pl (0.7% gain) and Sx (8% gain) in the base cases. No select seed was modeled in the TSR2 base case.
  - No cover constraint was modelled for mule deer winter range in TSR3. TSR2 ensured that at least 20% of the CFLB was older than 80 yrs old but also noted it was not constraining in the analysis (pg 24 of TSR2 AAC Rationale).
  - Spotted owl management is modelled in the TSR3 base case consistent with the MOU signed between licenses and the MoF (includes 7 LTAC's - 8459 ha of THLB). No constraints were applied in TSR2 for spotted owl.
  - More area was considered as community watersheds in TSR3 (including Gun and Twall creek watersheds). The additional area is approximately 2700 ha of THLB.
  - Spatially explicit Old Growth Management Areas (OGMAs) were implemented in the analysis. TSR2 used draft LU boundaries and applied percent seral goals using the 45/45/10 weighted average approach for biodiversity emphasis. Final LU's now exist and a new BEC coverage was completed in 2004.
  - TSR3 disturbed the nonTHLB areas at a rate of 948 ha/yr. TSR2 did not implement any disturbance in the NonTHLB.

4.0 Base Case Analysis (Current Practice)

The current practice base case scenario is based on the best information currently available and reflects current management practices in the TSA. The current allowable annual cut (AAC) for the Lillooet TSA is 635,900 m^3/yr (set January 1, 2002).

Non-recoverable losses of timber in the THLB are estimated to be 26,080 m^3/yr and have already been subtracted from the graphs, tables, and harvest forecasts presented in this report.

4.1 Alternative Harvest Flow Scenarios

Numerous alternative harvest forecasts are possible for a given set of modeling assumptions (i.e. the base case defined in Section 3.0). These alternative flows represent tradeoffs between short, mid, and long term harvest level objectives. Figure 11 shows three potential harvest flows for the Lillooet TSA base case assumptions.

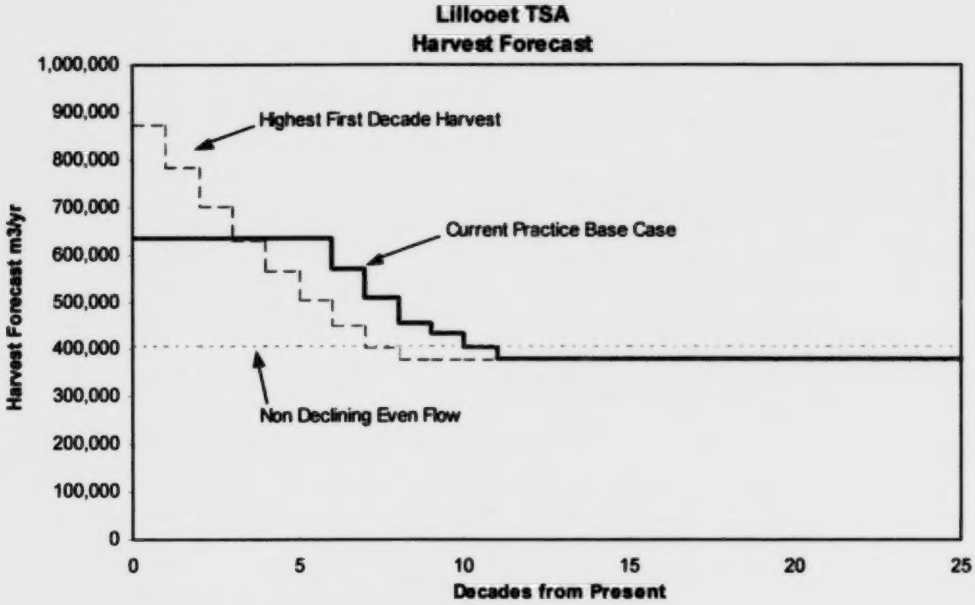

Figure 11. Alternative harvest forecasts for the Lillooet TSA (Current Practice)

Alternative 1 illustrates a high initial harvest rate (873,920 m3/yr) that decreases rapidly until the long term level is reached in the eighth decade (379,920 m^3/yr). This harvest rate is maintained for the remainder of the planning horizon.Alternative 2 seeks to maintain the current AAC of 635,900 m3/yr for as long as possible, and maximize the long-term harvest level. It is able to maintain the current AAC for 60 years, before declining to the long term level of 379,920 m3/yr in decade eleven. This harvest rate is maintained for the remainder of the planning horizon. Alternative 3 is a non-declining harvest scenario where the initial harvest level of 409,420 m3/yr is not allowed to drop. This harvest level is maintained for the entire planning horizon.

4.2 Selected Base Case Harvest Flow

Alternative 2 from Figure 11 above was selected to be the base case flow and is shown in detail in

Figure 12. This flow best meets the provincial policy of providing for a managed and gradual transition from short term to mid term to long term, by avoiding large and abrupt disruptions in timber supply. All of the harvest attributes and forest level attributes presented in this section correspond with this base case harvest forecast. All sensitivity analyses that follow in this section will be compared to this base case harvest forecast.

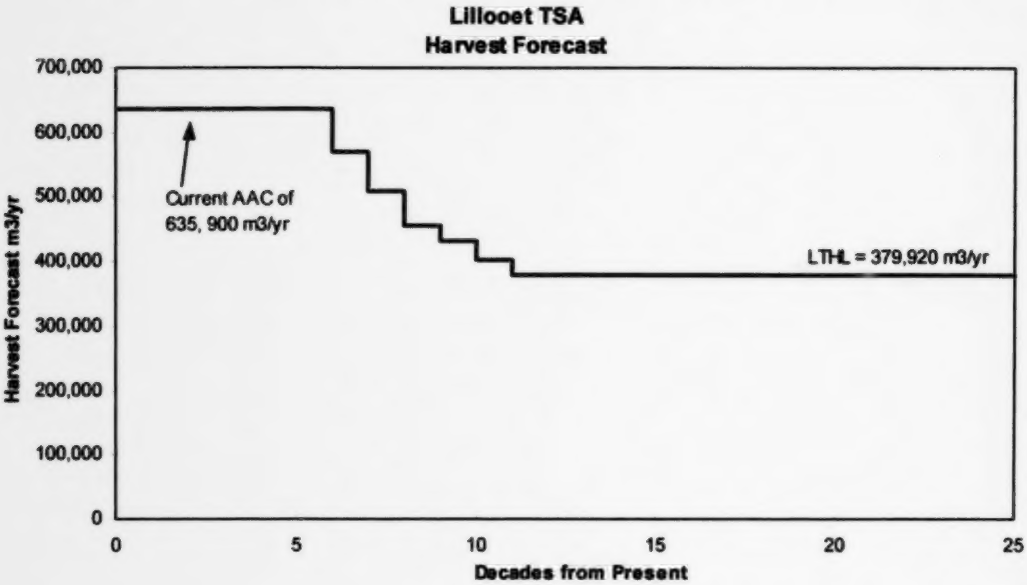

Figure 12. Current practice base case harvest forecast, Lillooet TSA

The base case is able to maintain the current AAC (635,900m^3/yr) for 60 years and then falls to a long term harvest level of 379,920 m^3/yr (40.3% below current AAC). The falldown consists of three 10% drops followed by three 5% drops.

4.3 Base Case Attributes

In order to understand and evaluate the base case harvest forecast, this section describes the stands being harvested over time and the corresponding state of the forest over time. Numerous forest management assumptions have been modeled in the base case analysis, many of which impact the condition of the forest through time. Using the information presented in this section, it is possible to validate these assumptions and review their impact on the overall composition of the forest.

4.3.1 Growing Stock

Figure 13 shows the total and merchantable volume of timber on the timber harvesting land base throughout the 250 planning horizon. The total growing stock is the net volume of all stands containing trees larger than specified minimum tree diametres (i.e. contain trees >12.5 or 17.5 cm dbh depending on species). The merchantable growing stock is the subset of total volume that comes from stands that are older than their specified minimum harvest age. A flat growing stock curve is desirable because it signals that the rate of harvest is roughly equal to the rate of forest growth.

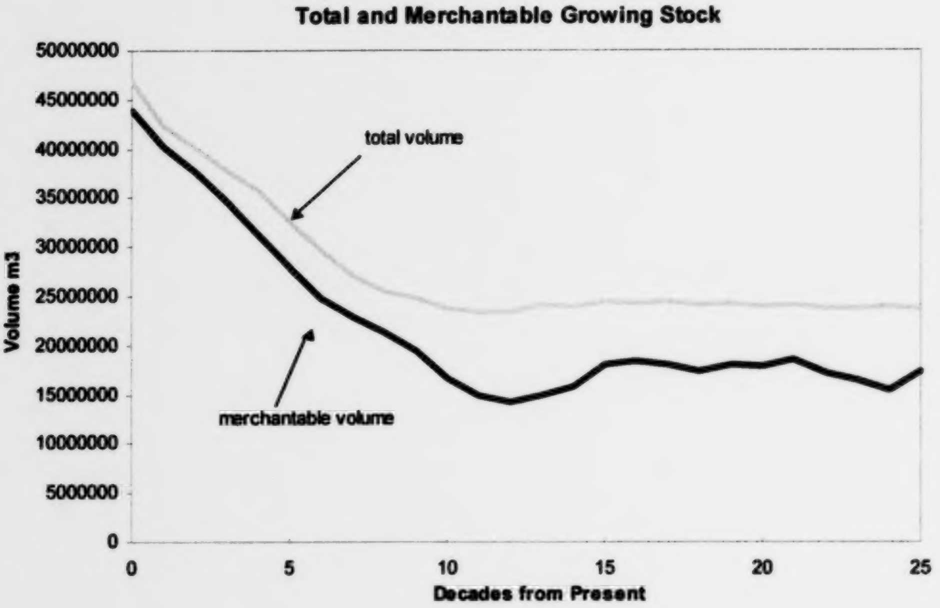

Figure 13. Merchantable and Total Growing Stock on the THLB

Of the total current volume (47 million m3), approximately 44 million cubic metres is currently merchantable. By comparison, the published TSR2 base case total growing stock was approximately 41 million cubic metres and the merchantable growing stock was approximately 39 million cubic metres. In both cases, the TSR3 stock is higher because of the statistical adjustment of the forest cover inventory attributes. Another, less significant, contributor is the difference between disturbance update currency (~2002) and the projection date (2004). This additional 2 years of growth add volume to the land base without any corresponding depletions/harvest. Merchantable growing stock reaches its lowest point near the twelfth decade, corresponding with the start of the long-term harvest level in the base case (

Figure 12). After decade 12, growing stock becomes relatively stable, meaning that the harvest of timber is roughly equal to the growth rate during this time.

4.3.2 Harvest Attributes

Figure 14 shows the contribution of both natural and managed stands to the base case harvest forecast. In the first 6 decades, the harvest of timber is exclusively from existing natural stands. In the 7th decade, managed stands start to come online and by the 9th decade, they make up more than half of the harvest volume. The transition to managed stands continues more gradually after the 9th decade, with natural stands contributing to the harvest throughout the planning horizon. All drybelt Fd stands are considered natural stands (remain on VDYP curves) throughout the planning horizon.

The base case harvest forecast has various species and stand types contributing to the overall harvest, often at different times. Figure 15 below shows the contribution of the four key stand types over the planning horizon.

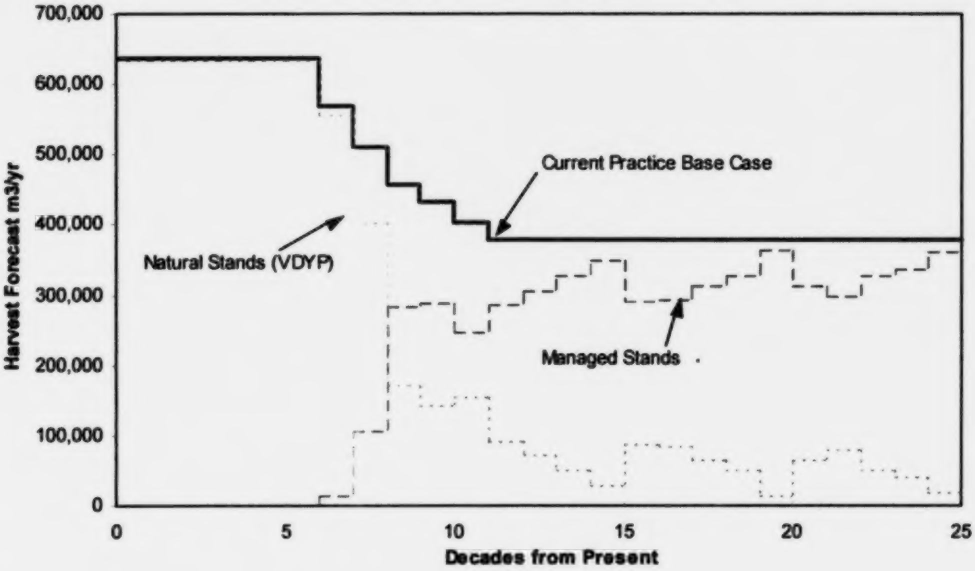

Figure 14. Contribution of natural and managed stands to the base case harvest projection

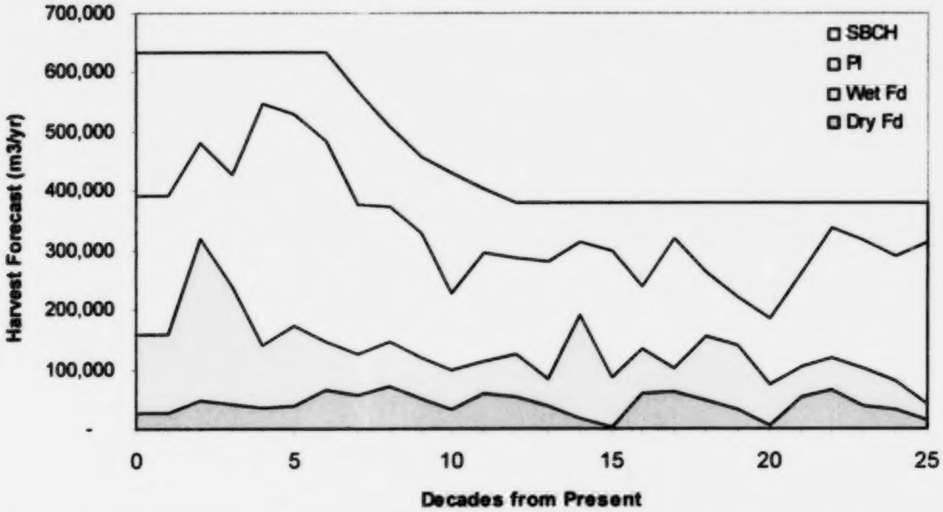

Figure 15. Contribution of species groups to the base case harvest projection

Mean harvest age provides an indicator of the type and age of stands harvested over time. The timber harvesting land base is currently dominated by older natural stands that are being replaced by younger managed stands over the next 100 years.

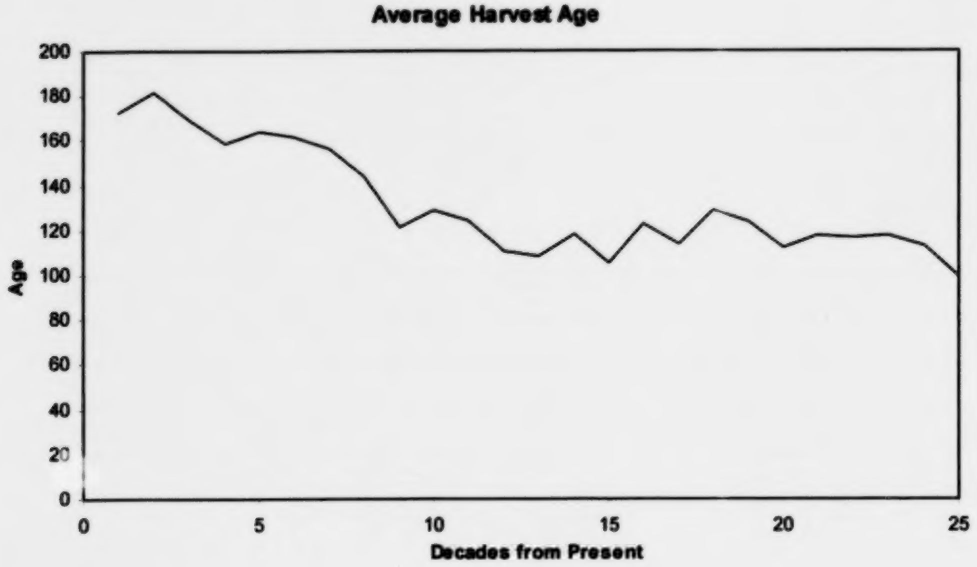

Figure 16. Mean harvest age for current practice base case

Figure 16 shows that in the short term, mean harvest age is 160-180 years old. This high initial harvest age is primarily due to the presence of old and mature timber stands on the land base and the 'relative-oldest-first' harvest priority. The harvest age declines gradually as these mature timber stands are harvested and replaced with managed stands. The longer term harvest ages are typically 100 to 120 years old (average of 116 yrs) as managed stands are typically cycling near their minimum harvest ages.
Figure 17 provides the mean harvest volume/hectare over time for the base case. Older, higher volume natural stands are harvested first resulting in an average harvest volume of ~300 m3/ha. The volume gradually declines to its lowest level in decade 14 (~160 m3/ha) where the harvest is coming almost entirely from managed stands. Higher productivity stands are being harvested in the 20th decade resulting in a spike in volume per hectare harvested in this period.

Over the planning horizon, the average volume per hectare is 231 m3/ha. Within the first 50 years the volume harvested averages 296 m3/ha and decreases to 201 m3/ha over the remainder of the planning horizon.

Harvest area has an inverse relationship with harvest volume per hectare. As harvest volumes/ha go up, the harvest area goes down, and vice versa. Figure 18 shows the annual harvest area for the TSA projected in the base case. Harvest area is relatively stable from decade 1 to 10 with an average of 2,265 hectares per year harvested. Harvest area begins to fluctuate after decade 10 as natural stands are depleted and the switch is made to managed stands. Higher productivity stands are being harvested in the 20th decade resulting in a significant decrease in harvest area required to meet the annual harvest volume.

Over the entire planning horizon, the annual harvest area averages 2,379 ha (unsalvaged losses removed). Within the first 50 years the harvest area averages 2,344 ha/yr and increases slightly to 2,358 ha/yr over the remainder of the planning horizon.

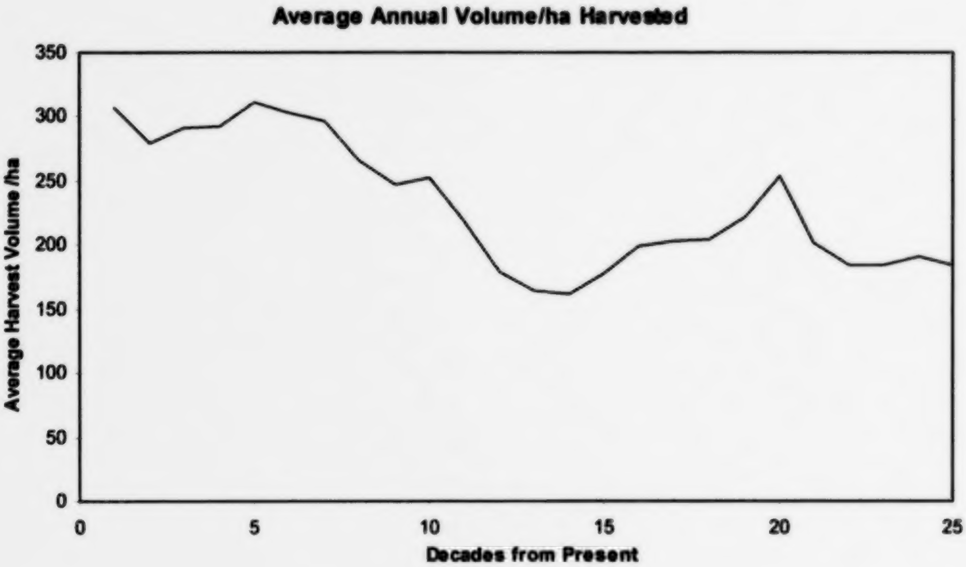

Figure 17. Mean annual harvest volume/ha for the current practice base case

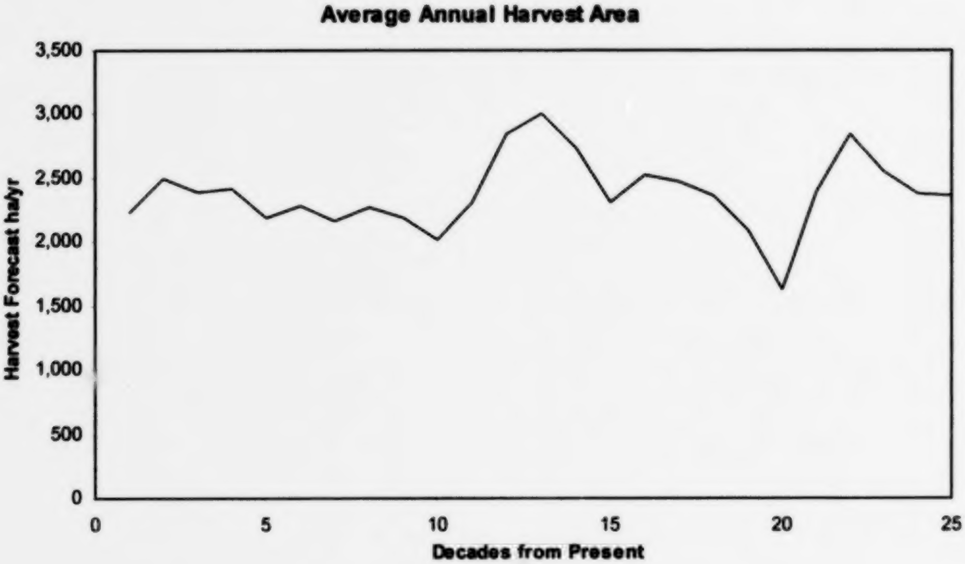

Figure 18. Total harvest area per year for the current practice base case

4.3.3 Age Class Distribution

Figure 19 provides a time-series showing the age-class distribution of the TSA's forest in 50 year increments. The present day stand ages are well distributed over a wide range of age classes, with most area falling within the 90-160 age classes. The ages on the non-contributing forest are fairly well distributed across all of the age classes but the non-contributing area does tend to be older than the THLB area. The younger age classes are dominantly THLB. Currently, there is very little forest between 30 and 50 years of age on the TSA. By 100 years into the future (just prior to the start of the long-term harvest level), the timber harvesting land base is becoming evenly distributed in the age classes below typical rotation ages (≤120 yrs).

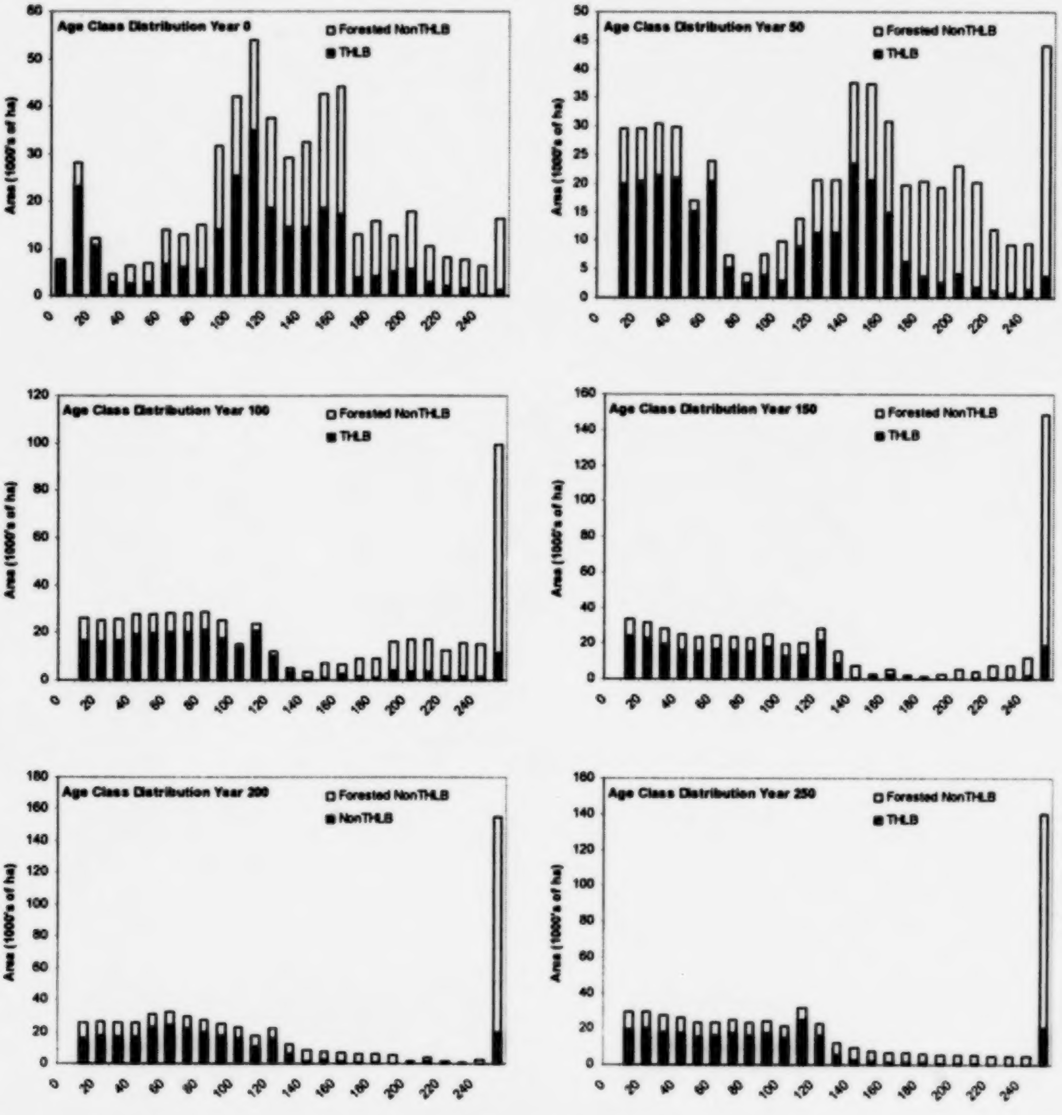

Figure 19. Age class composition of the Lillooet TSA: six snapshots from the base case

The 250 year snapshot shows an even distribution of THLB stands in the 10-120 year age classes with smaller amounts of area in the age classes >130, corresponding with stands with longer rotation ages. Also of note in the 250 year snapshot is that over 27,787 ha of THLB exist in ages over 150 yrs, with the vast majority coming from stands over 250 years old. These are areas of THLB that are constrained to an extent that timber harvesting is prevented (i.e. OGMAs), and represents over 12% of the long-term timber harvesting land base.

The modeling of natural disturbance in the non-THLB leads to the creation of a relatively even distribution of non-THLB stands through most of the age classes. The 250 year snapshot shows a well-distributed non-contributing land base and a large area of non-contributing that has aged to >250 years.

4.4 Constraints Analysis

In the base case analysis, several cover constraints are modeled to ensure that non-timber values are represented on the land base. These constraints address issues related to wildlife habitat, community watersheds and visual quality, and are described in Section 3.3.1. This section of the report provides a status summary of the most significant cover constraints modeled in the base case over the 250 year planning horizon.

Landscape Level Biodiversity:
Spatial OGMAs were implemented in the model for the duration of the planning horizon and thus act like netdowns during modeling. Of the 16,079 ha of OGMA in the THLB, only 5,489 ha overlap into areas where other constraints are active (VQOs, CWS's, Spotted Owl).

VQO's:
VQOs were implemented as maximum disturbance constraints (i.e. greenup constraints). Of the 66,646 ha of THLB impacted by VQO's, only 22% of this area was at or above constraint thresholds in the first 2 decades (i.e. harvesting was restricted or prevented). As the planning horizon progressed, a larger portion of the VQO constraint area was pushed up to threshold levels. In the later half of the planning horizon, roughly ¾ of the Retention VQO area was actively limiting harvest, 2/3 of the Partial Retention VQO area was actively limiting harvest, and ½ of the Modification VQO area was actively limiting harvest from occurring. These limitations do not necessarily translate into timber supply impacts if the harvest can be moved elsewhere in the TSA (refer to green-up sensitivity analysis).

Community Watersheds:
CWS's were implemented as maximum disturbance constraints (i.e. greenup constraints) and had the potential to impact 22,092 ha of THLB. Only the Gladwin Creek and Nikaia Creek CWS's were at threshold levels at the start of the planning horizon and thus prevented harvest in 888 ha of THLB. Murray Creek CWS also became limiting in the second period and by the 5th period, over 80% of the CWS area was limiting harvest to some degree. Over the long term, approximately 65% of the THLB impacted by CWS's was at or near threshold levels while the remaining watersheds were below thresholds. These limitations do not necessarily translate into timber supply impacts if the harvest can be moved elsewhere in the TSA (refer to greenup sensitivity analysis).

IRM Greenup:
Greenup constraints were applied to the entire THLB area and evaluated at the landscape unit level. No landscape units were at threshold levels at the start of the planning horizon, and they remained in this state until the 3rd period when the Connel, Bridge, and Yalakom LU's began to limit harvest. Throughout the rest of the planning horizon the area where IRM greenup constraints were actively limiting harvest typically ranged from 0-15%. These limitations do not necessarily translate into timber supply impacts if the harvest can be moved elsewhere in the TSA (refer to greenup sensitivity analysis).

Spotted Owl:
Two spotted owl cover constraints (mature and old) were implemented in the base case to maintain older forests within Long Term Activity Centers (LTAC's). The LTAC's impact on 16,079 ha of THLB. The requirement to maintain 67% of the LTAC's in stands over 100yrs old resulted in two LTAC's (Lost Valley Creek and Kwoiek) restricting harvest at the start of the planning horizon. As harvesting occurred in the other LTAC's over time, the

vast majority of the LTAC's began to limit harvest. They remained in this state for the duration of the planning horizon, allowing only small harvests each decade. The second requirement to maintain 50% of the LTAC's in stands over 140 years old resulted in all LTAC's having harvest restrictions for the first 2 periods. Over time, this constraint became less active because the 67% constraint tended to hold enough older stands to satisfy this constraint as well. The two constraints act together to severely restrict harvesting within the LTAC's during most periods of the planning horizon.

4.5 Base Case Differences from TSR2

Relative to TSR2 (no PA16 included), the base case presented here shows an improved harvest forecast. This section is meant to summarize and explain, where possible, the main differences between the harvest flows. Detail on the different inputs and assumptions included in the two analyses can be found in Section 3.6.

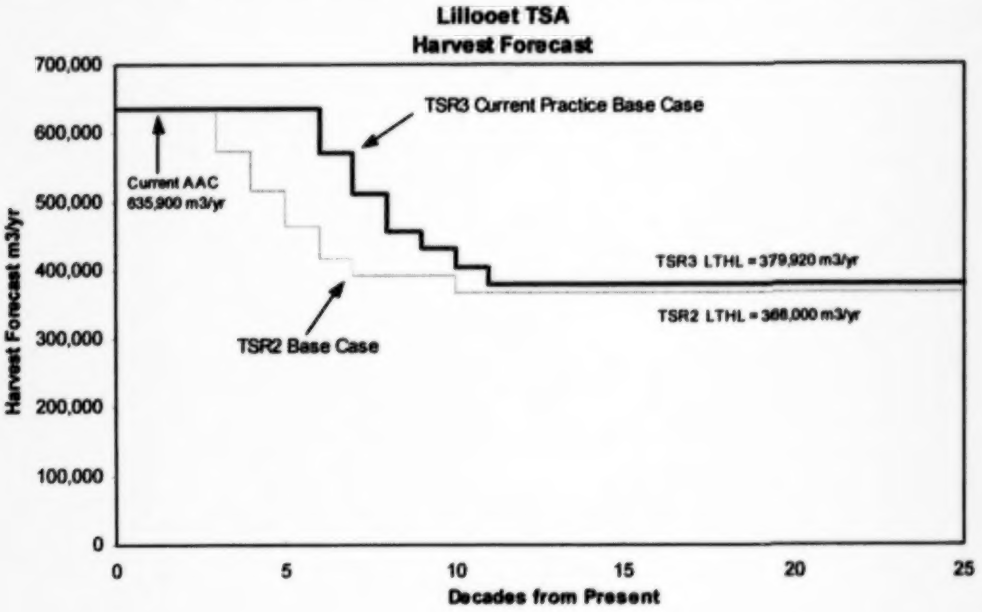

Figure 20. TSR3 current practice base case and TSR2 (without PA16) harvest projections

Downward pressures on TSR3 current practice base case relative to TSR2

- The current THLB appears to be smaller even when PA16 is removed because of increased woodlot and archaeological removals and the exclusion of the Spruce Lake protected area. These reductions are partially offset by reduced netdowns for unstable terrain. The size of this reduction is difficult to determine as THLB numbers were not published for TSR2 without PA16.
- Spotted owl cover constraints reduce timber availability in small portions of the TSA in TSR3.
- Disturbance was implemented in the NonTHLB in TSR3.
- Additional area (~2700 ha) is modeled under community watershed constraints in TSR3.

Upward pressures on timber supply relative to TSR2

- TSR3 initial growing stock is significantly increased as a result of the inventory adjustment process. Growing stock is also high because volumes were projected to 2004 but disturbance in the inventory is only current to 2002.
- TSR3 long term productivity levels are improved because site indexes were generally improved as a result of the inventory adjustment.
- TSR3 contains volume gains associated with the use of select seed in managed stand yield curves. No such gains were modeled in TSR2. This difference improves long-term yields and may be helping with mid-term harvest levels.

Unknown or similar influence on timber supply relative to TSR2

- OGMA's are spatially defined in TSR3 for the duration of the planning horizon. Spatial OGMAs likely have a downward pressure in the long term as seen in Section 6.7 of this report.

4.6 Base Case Sensitivity Analyses

The data and assumptions used in any timber supply analysis are often subject to uncertainty. To provide perspective on the sensitivity of changes to modeled assumptions, sensitivity analyses are commonly performed. Typically only one variable (data or assumption) from the information used in the base case is changed in order to explore the sensitivity of that variable. Sensitivity analyses help to frame the potential impacts of uncertainty by analyzing scenarios that are more pessimistic and more optimistic than the base case.

The sensitivities listed in Table 5 were performed on the base case and the results are presented below. Where relevant, any crashes that occurs while attempting to achieve the base case harvest flow are also shown.

Table 5. Sensitivity analyses completed on the current practice base case

Sensitivity analysis	**Zone/ group / analysis unit subject to uncertainty**	**Changes made in Sensitivity Run**
Size of THLB	Timber Harvesting Land Base (THLB)	The timber harvesting land base will be increased and decreased by 10%. NCLB is decreased by same area.
Natural Stand Yields	Natural Stands	The volume associated with VDYP curves will be increased and decreased by 10% (100 and 1000 series AU's)
Managed Stand Yields	Managed Stands	The volume associated with TIPSY curves will be increased and decreased by 10% (200, 500, and 600 series AU's)
Minimum Harvest Ages	All Stands	Minimum Harvest ages will be increased and decreased by 10 years.
Harvest Priorities	Timber Harvesting Land Base (THLB)	Relative Oldest First harvest rule replaced with Oldest First rule
Greenup Ages	Area of VQO, IRM greenup and CWS constraints.	Greenup ages for VQO's, IRM greenup, and community watershed constraints will be altered by +/- 5 yrs.

4.6.1 Size of Timber Harvesting Land Base

Several factors that determine of the size of the THLB have uncertainty around their definitions (operable area, problem types, low sites, riparian management, impacts from trails and landings, etc). Different market conditions in the future or changes in harvesting or milling technology can also serve to reduce or expand the land base considered to be economic.

It is not known whether the THLB used in this analysis has been over- or under-estimated. Two sensitivity runs have been completed to assess this uncertainty. These runs increase and decrease the size of the THLB by 10%.

How was it Analyzed?

Run	How was it Analyzed?
Timber harvesting land base + 10%	The size of each THLB polygon was increased by 10%, while the size of NonTHLB polygons were decreased by the corresponding percentage that maintained the correct total land base area. The increased THLB was 275,469 ha in size.
Timber harvesting land base - 10%	The size of each THLB polygon was decreased by 10%, while the size of NonTHLB polygons were increased by the corresponding percentage that maintained the correct total land base area. The decreased THLB was 225,383 ha in size.

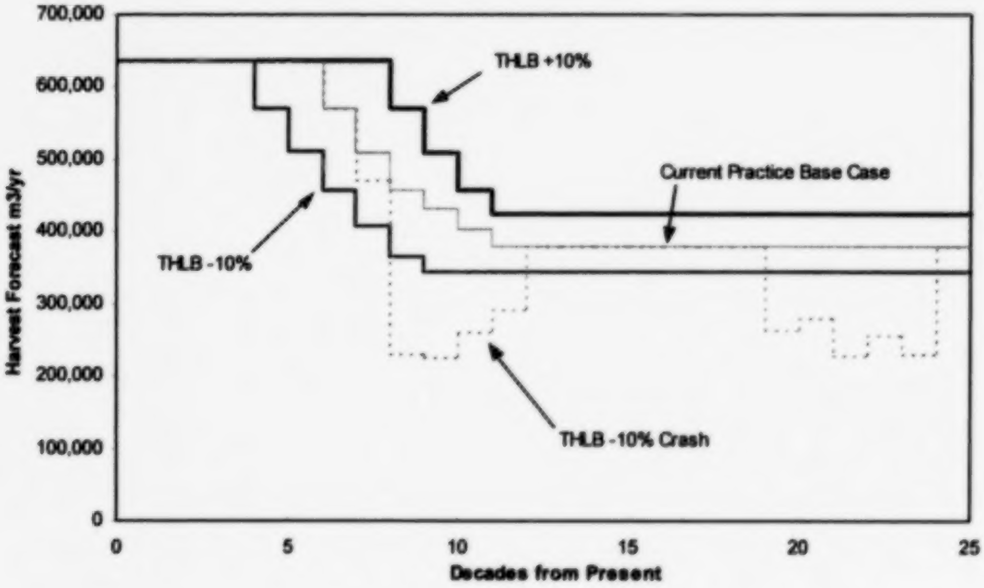

Figure 21. Timber harvesting land base increased and decreased by 10% (Current Practice)

Results

Run	Short Term	Mid Term	Long Term
Timber Harvesting Land Base + 10%	The current AAC (635,900 m^3/yr) is maintained for 2 additional decades.	No change	The LTHL increases 11.6% to 423,920 m3/yr.
Timber Harvesting Land Base - 10%	The current AAC (635,900 m^3/yr) is maintained for 2 fewer decades.	Transition to LTHL occurs 2 decades earlier.	The LTHL decreases 9.7% to 342,920 m3/yr.

4.6.2 Yields from Natural and Managed Stands

Stand yields are a critical input into timber supply analysis. The short and mid-term timber supply is heavily influenced by the availability of timber in natural stands that make up the current growing stock. The current standing and mature timber provide all of the timber harvesting opportunities before managed stands begin to come online for harvest.

Uncertainty in timber yields can result from many different factors. Natural stand yields are based on the VDYP yield model, which predicts yields from stand attributes in forest inventory maps. Inaccuracies in the model, in decay estimates, or stand attributes can create uncertainties around actual stand yields. In this TSA, a recent VRI phase 2 sampling project was used to adjust natural stand volume estimates based on ground plot data and thus the volume estimates are expected to be reasonably accurate.

Managed stand yields are based on the TIPSY growth model, which predicts yields from estimates of site index, and stand attributes such as species, density, and expected gains from planting stock grown from select seed. The over or under estimation of any of these factors can lead to uncertainties in the yields of these future stands.

How was it Analyzed?

Run	How was it Analyzed?
Natural Stands + 10% (VDYP + 10%)	The yield associated with each natural stand analysis unit (100 and 1000 series) was increased by 10%.
Natural Stands - 10% (VDYP – 10%)	The yield associated with each natural stand analysis unit (100 and 1000 series) was decreased by 10%.
Managed Stands + 10% (TIPSY + 10%)	The yield associated with each existing managed and future managed stand analysis unit (200, 500, 600 series) was increased by 10%.
Managed Stands - 10% (TIPSY – 10%)	The yield associated with each existing managed and future managed stand analysis unit (200, 500, 600 series) was decreased by 10%.

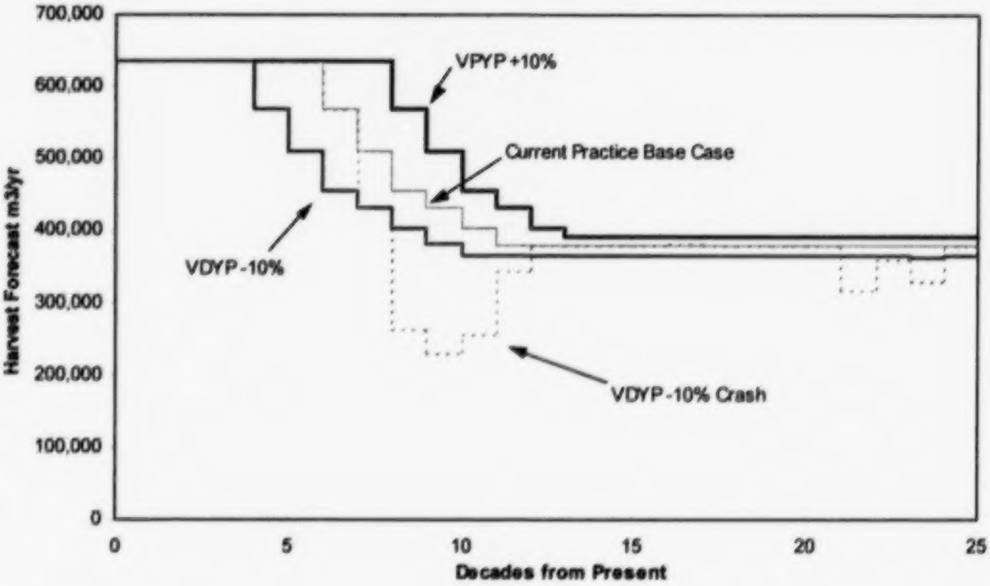

Figure 22. Natural stand (VDYP) yields increased and decreased by 10% (Current Practice)

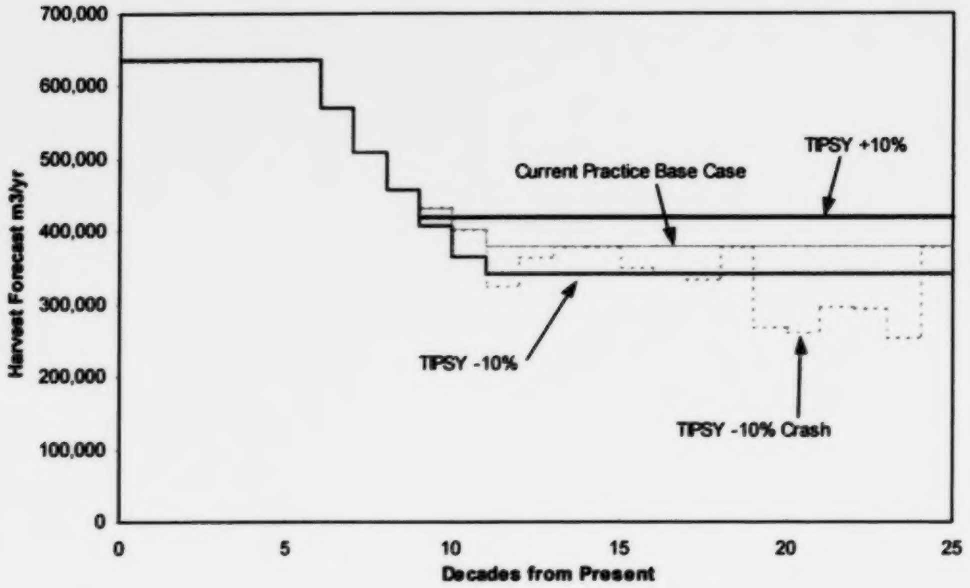

Figure 23. Managed stand (TIPSY) yields increased and decreased by 10% (Current Practice)

Results

Run	Short Term	Mid Term	Long Term
Natural Stands +10%	The current AAC (635,900 m^3/yr) is maintained for 2 additional decades.	Transition to LTHL occurs 2 decades later.	The LTHL increases by 3.2% to 391,920 m3/yr.
Natural Stands -10%	The current AAC (635,900 m^3/yr) is maintained for 2 fewer decades.	Transition to LTHL occurs 1 decade earlier.	The LTHL decreases by 3.9% to 365,220 m3/yr.
Managed Stands +10%	No change.	Transition to LTHL occurs 2 decades earlier.	The LTHL increases by 10.3% to 418,920 m3/yr.
Managed Stands -10%	No change.	No change.	The LTHL decreases by 9.7% to 342,920 m3/yr.

Changes to natural stands yields have significant impacts on the length of time the current AAC can be maintained because it is this stock of existing volume that must be metreed out until managed stands come online in significant volumes. Natural (VDYP) yields area also affecting the long term because the drybelt fir stands remain on these curves throughout the analysis and thus contribute more/less volume throughout the planning horizon.

Changes to managed stand yields have no impact in the short term but do have significant impacts in the long term. The scale of the impact is almost directly proportional with the over/under estimation of volume.

4.6.3 Minimum Harvest Ages

Uncertainty around the age that stands become merchantable for harvest is linked to both our ability to predict the future growth of stands and our ability to understand future conditions that will define merchantability (markets / products). It is important to note that minimum harvest ages are only meant to approximate the time when a stand first becomes merchantable, and that harvesting can and does occur well beyond these ages in the model.

It is unknown if there are more appropriate minimum harvest ages than those used in the base case, so sensitivity runs have been completed to explore the impact of both higher and lower ages.

How was it Analyzed?

Run	How was it Analyzed?
Min Harvest Ages decreased by 10yr	Minimum harvest ages for each AU were decreased by 10 years.
Min Harvest Ages increased by 10yr	Minimum harvest ages for each AU were increased by 10 years.

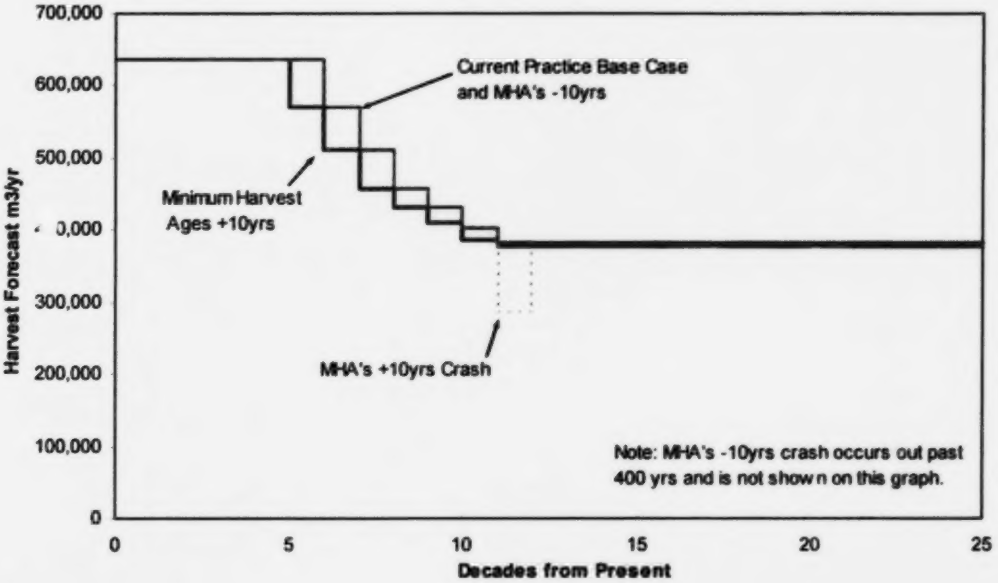

Figure 24. Minimum harvest ages increased and decreased by 10 years (Current Practice)

Results

Run	Short Term	Mid Term	Long Term
Min Harvest Ages decreased by 10yr	No change.	No change.	LTHL decreases by 0.8% to 376,920 m3/yr.
Min Harvest Ages increased by 10yr	The current AAC maintained for 1 less decade.	No change.	LTHL increases by 0.5% to 381,920 m3/yr.

The base case forecast is somewhat sensitive to increased minimum harvest ages because it delays the availability of managed stands and forces existing volumes to be metered out more slowly (e.g. causes fall down to start one decade earlier). The increased harvest age results in managed stands being harvested closer to culmination age and thus slightly increases the long-term harvest level.

The opposite is true when harvest ages are decreased – long term harvests decrease by 0.8% because harvesting is typically occurring further away from culmination ages. The decrease does not result in any change in the short term because the increased flexibility afforded by reduced ages does not offset the lower volumes achieved.

4.6.4 Harvest Priorities

Harvest priorities help to establish the order in which stands will be scheduled for harvest by the model.

This sensitivity looks at the effect of replacing the relative-oldest-first priority in the base case with an absolute-oldest-first priority. An absolute oldest first rule will select the oldest available stands for harvest first without consideration of minimum harvest ages.

How was It Analyzed?

Run	How was it Analyzed?
Absolute Oldest First	In the timber supply model – the harvest rule was changed to absolute oldest first from relative oldest first.

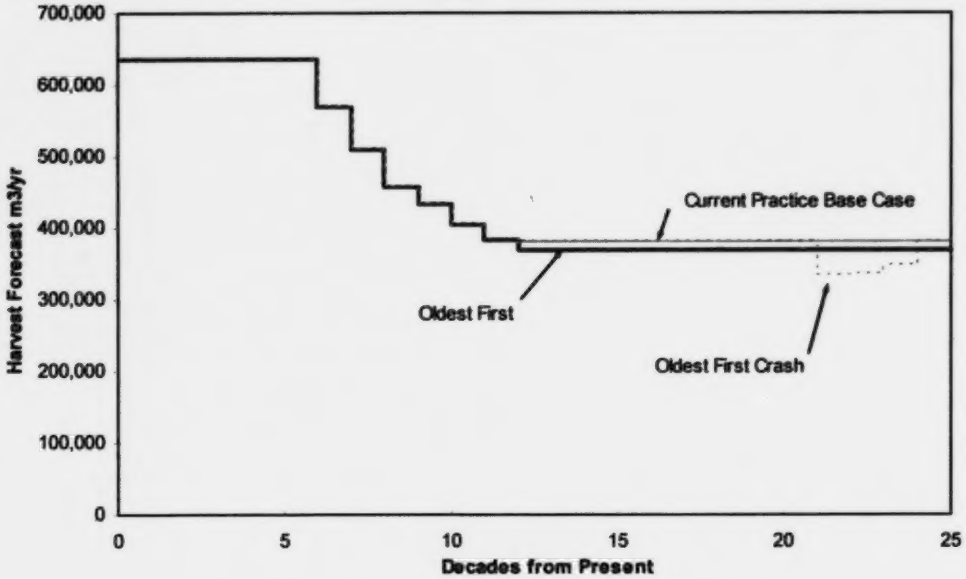

Figure 25. Alternative harvest priorities – absolute oldest first (Current Practice)

Results

Run	Short Term	Mid Term	Long Term
Absolute Oldest First	No change.	No change.	The LTHL decreases by 2.9% to 368,920 m3/yr.

A relative oldest first priority had no impact on the short or mid term harvest forecast but caused a 3% reduction on the long term forecast.

4.6.5 Greenup Ages

Constraints for visual quality, IRM green-up, and community watersheds limit the amount of area that can be under specific heights throughout the planning horizon. Greenup ages are used in the modeling process to indicate the length of time it takes stands to reach these heights. The analyses presented here are designed to explore how sensitive the harvest projections are to the green-up ages used in the base case.

How was it Analyzed?

Run	How was it Analyzed?
Greenup ages decreased by 5yr	Greenup ages for VQO's, IRM greenup, and community watershed constraints were decreased by 5 yrs
Greenup ages increased by 5yr	Greenup ages for VQO's, IRM greenup, and community watershed constraints were increased by 5 yrs

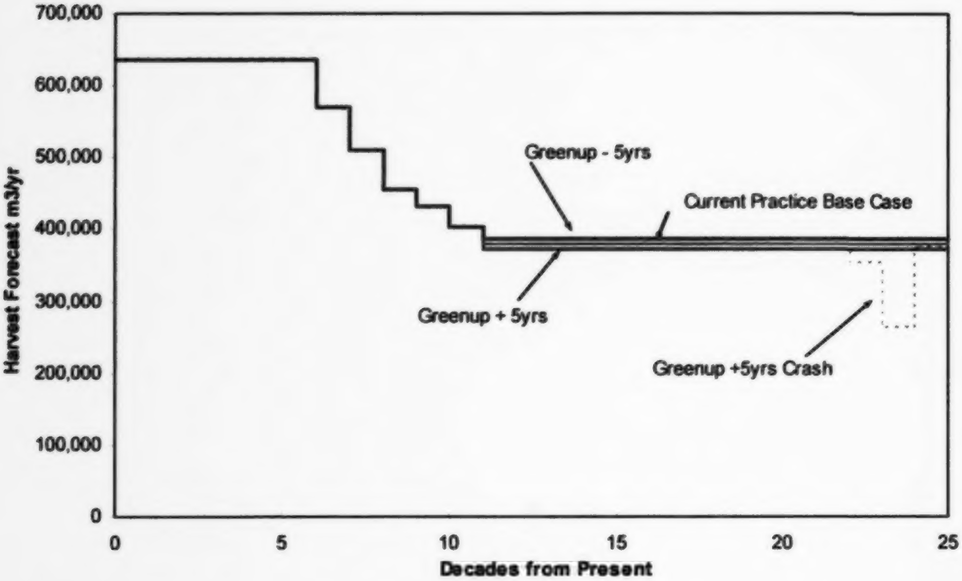

Figure 26. Alternative greenup times for VQOs, IRM greenup, and CWSs (Current Practice)

Results

Run	Short Term	Mid Term	Long Term
Greenup ages decreased by 5yr	No change.	No change.	LTHL increases by 1.8% to 386,920 m3/yr.
Greenup ages increased by 5yr	No change.	No change.	LTHL decreases by 2.1% to 371,920 m3/yr.

The short and midterm harvest projections are not sensitive to green-up ages but the long-term harvest level fluctuates by approximately 2% under the two scenarios. Longer green-up ages result in less timber available for harvest per year while shorter green-up ages allow for more flexibility in harvest scheduling. The scale of the change in these analyses indicates that green-up times are not a major influencing factor in this TSA.

5.0 LRMP Scenario Analysis

The scenario presented in this section reflects management practices that would be implemented upon cabinet approval of the July 2004 Draft Lillooet LRMP document. This additional base case and series of sensitivity analyses were completed to provide context around LRMP impacts and support an AAC determination in the case where cabinet approves the LRMP prior to the determination-taking place.

As in the current practice base case, non-recoverable losses in the THLB are estimated to be 26,080 m^3/yr and have already been subtracted from the graphs, tables, and harvest forecasts presented in this report.

5.1 Alternative Harvest Flow Scenarios

As with the current practice base case, numerous alternative harvest forecasts are possible for a given set of modeling assumptions. These alternative flows represent tradeoffs between short, mid, and long term harvest level objectives. Figure 11 shows three potential harvest flows for the Lillooet TSA LRMP assumptions.

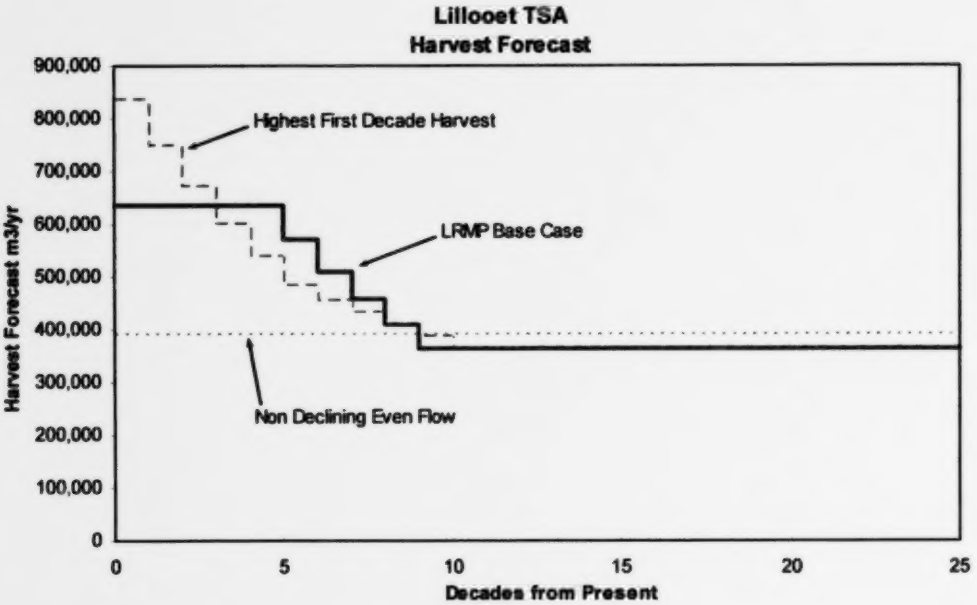

Figure 27 . Alternative harvest forecasts for the LRMP base case

Alternative 1 illustrates a high initial harvest rate (834,000 m3/yr) that decreases rapidly until the long term harvest level is reaching in the tenth decade (364,420 m^3/yr). This harvest rate is maintained for the remainder of the planning horizon.

Alternative 2 seeks to maintain the current AAC of 635,900 m3/yr for as long as possible, and maximize the long-term harvest level. It is able to maintain the current AAC for 50 years, before declining to a low of approximately 364,420 m3/yr in decade nine. This harvest rate is maintained for the remainder of the planning horizon. Alternative 3 is a non-declining harvest scenario where the initial harvest of approximately 390,800 m3/yr is not allowed to drop. This harvest level is maintained for the entire planning horizon.

5.2 Selected LRMP Harvest Flow

Alternative 2 from

Figure 27 was selected to be the LRMP base case flow and is shown in detail in Figure 28. This flow best meets the provincial policy of providing for a managed and gradual transition from short term to mid term to long term, by avoiding large and abrupt disruptions in timber supply. All of the harvest attributes and forest level attributes presented in this section correspond with this LRMP base case harvest forecast. All sensitivity analyses that follow in this section of the document will be compared to this LRMP base case harvest forecast.

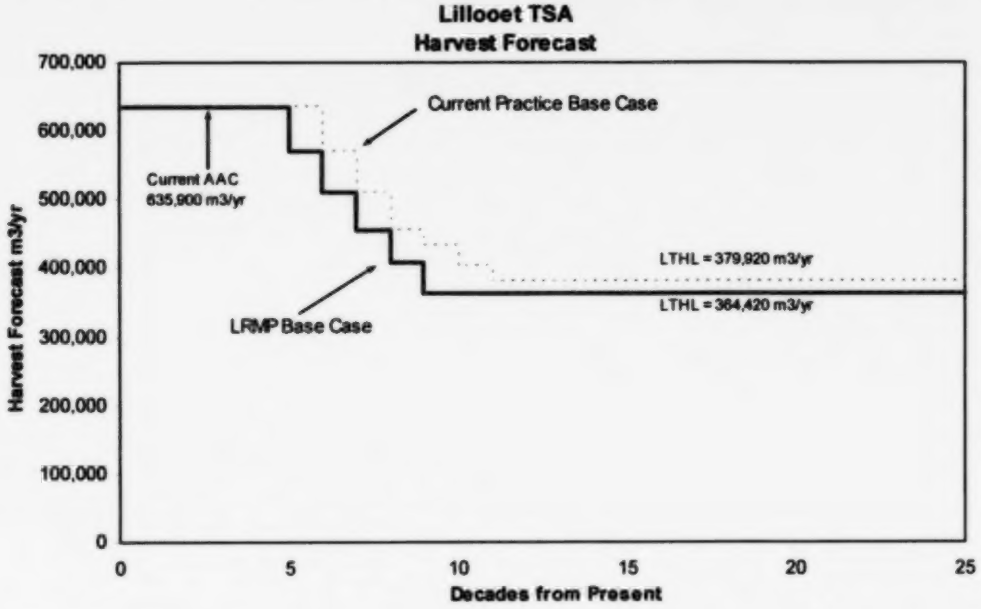

Figure 28. LRMP base case harvest forecast, Lillooet TSA

When compared to the current practice base case (Figure 28), the LRMP base case is able to maintain the current AAC for one less decade (50 yrs) and falls more quickly to a long-term harvest level that is reduced by 4.1% (364,420 m3/yr). These results occur primarily because of a reduced THLB area (new parks) and reduced access to timber (grizzly bear reserves, MDWR cover constraints). These downward pressures are partially offset by the relaxed spotted owl constraint and reduce area managed as visuals.

5.3 LRMP Scenario Attributes

In order to understand and evaluate the LRMP base case harvest forecast, this section describes the stands being harvested over time and the corresponding state of the forest over time. Numerous forest management assumptions have been modeled in the LRMP analysis, many of which impact the condition of the forest through time. Using the information presented in this section, it is possible to validate these assumptions and review their impact on the overall composition of the forest.

5.3.1 Growing Stock and Timber Availability

Figure 29 shows the total and merchantable volume of timber on the timber harvesting land base throughout the 250 planning horizon. The total growing stock is the net volume of all stands containing trees larger than specified minimum tree diametres (i.e. contain trees >12.5 or 17.5 cm dbh depending on species). The merchantable growing stock is the subset of total volume that comes from stands that are older than their specified minimum harvest age. A flat growing stock curve is desirable because it signals that the rate of harvest is roughly equal to the rate of forest growth.

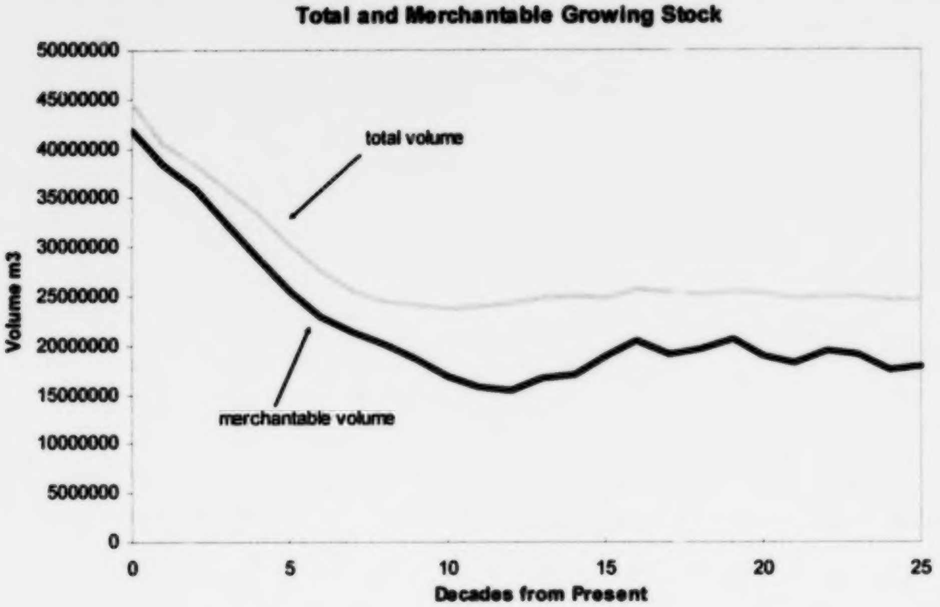

Figure 29. Merchantable and Total Growing Stock on the THLB

Of the total current volume on the THLB (45 million cubic metres), approximately 42 million cubic metres is currently merchantable. Growing stock is lower than seen with the current practice base case because of the reduced size of the THLB (removal of LRMP parks).Merchantable growing stock reaches its lowest point near the twelfth decade (

Figure 29), just after the long term harvest level is reached. After decade 12, growing stock becomes relatively stable over the long term, meaning that the harvest of timber is roughly equal to the growth rate during this time.

5.3.2 Harvest Attributes

Figure 30 shows the contribution of both natural and managed stands to the LRMP base case harvest forecast. In the first 6 decades, the harvest of timber is exclusively from existing natural stands. In the 8th decade, the harvest of natural stands begins to drop sharply as existing managed stands become available for harvest and by the 9th decade they make more than half of the harvest volume. The transition to managed stands continues more gradually after the 9th decade with natural stands contributing to the harvest throughout the planning horizon (i.e. dry belt Fd stands).

The base case harvest forecast has various species and stand types contributing to the overall harvest, often at different times. Figure 31 shows the contribution of the four key species groups over the planning horizon.

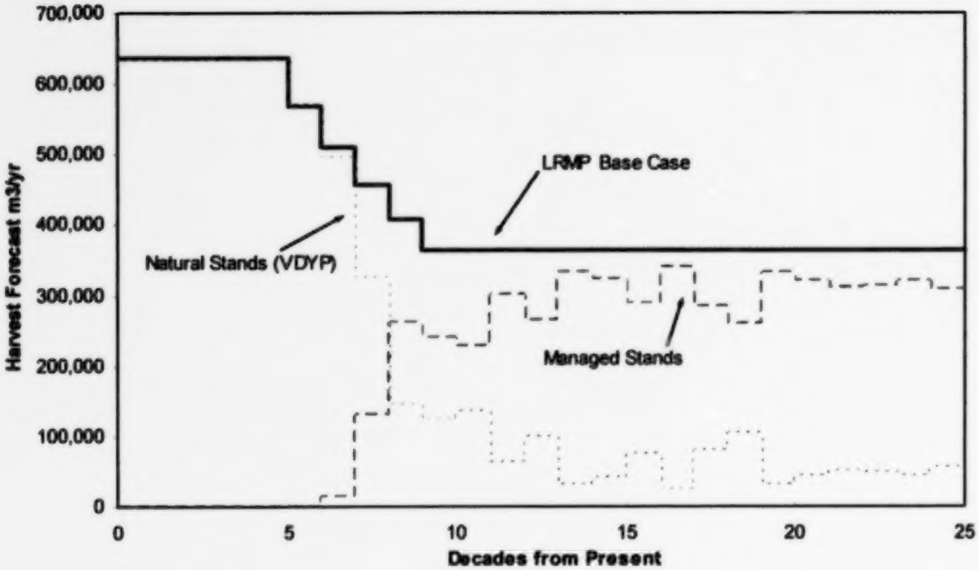

Figure 30. Contribution of natural and managed stands to the LRMP base case.

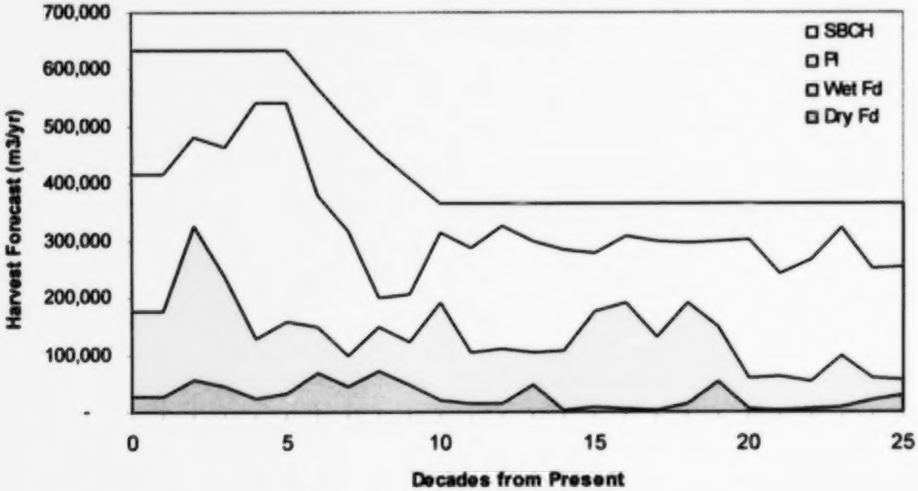

Figure 31. Contribution of species groups to the LRMP base case forecast

Mean harvest age provides an indicator of the age of stands harvested over time. The timber harvesting land base is currently dominated by older natural stands that are being replaced by younger managed stands over the next 100 years (

Figure 32).

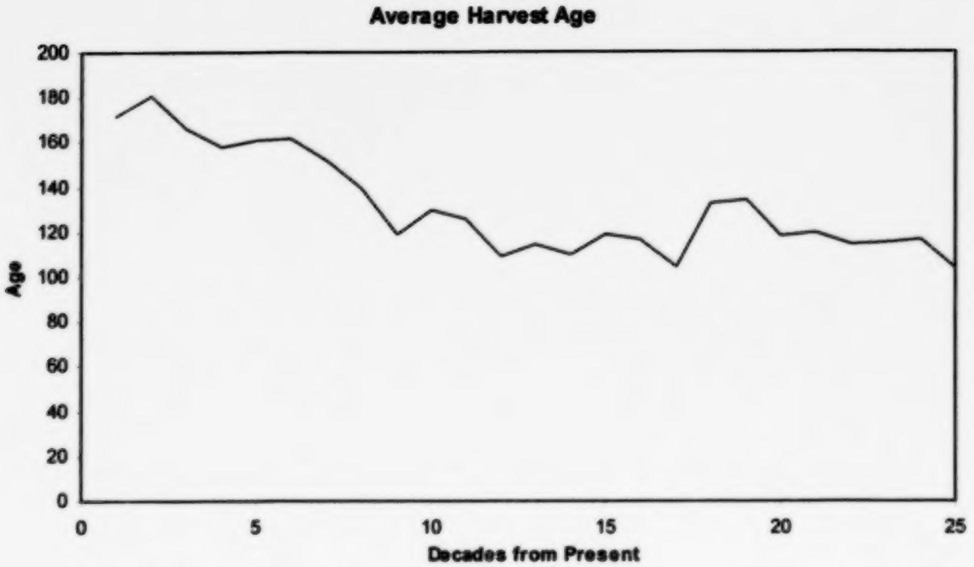

Figure 32. Mean harvest age over time for the LRMP base case

In the short term, mean harvest age is 170-180 years old. This high initial harvest age is primarily due to the presence of old and mature timber stands on the land base and the relative oldest first harvest priority. The harvest age declines gradually as these older stands are harvested and then stabilizes around 110-120 years old as managed stands make up the bulk of the harvest.

Figure 33 outlines the mean harvest volume per hectare over time for the LRMP base case. Older, high volume natural stands are harvested first resulting in an average harvest volume of 275-300 m3/ha. The volume gradually declines to its lowest level in decade 14 (~160 m3/ha). Higher productivity stands are being harvested in the 20th decade resulting in the spike in volume per hectare harvested observed for this period. The average long term harvest volume is 205 m3/ha.

Total harvest area has a reverse relationship with harvest volume per hectare. As harvest volume goes up, the harvest area goes down, and vice versa.

Figure 34 shows the total harvest area in the TSA for the LRMP base case. Harvest area is steadily declining from decades 1 to 10 with an average of 2,181 hectares per year harvested. Harvest area begins to fluctuate after decade 10 as natural stands are generally depleted and the switch is made to managed stands. Higher productivity stands are being harvested in the 20th decade resulting in a significant decrease in harvest area required to meet the annual harvest volume.

Over the entire planning horizon, the annual harvest area averages 2,281 ha (unsalvaged losses area removed). Within the first 50 years the harvest area averages 2,349 ha and decreases to 2,282 ha over the remainder of the planning horizon.

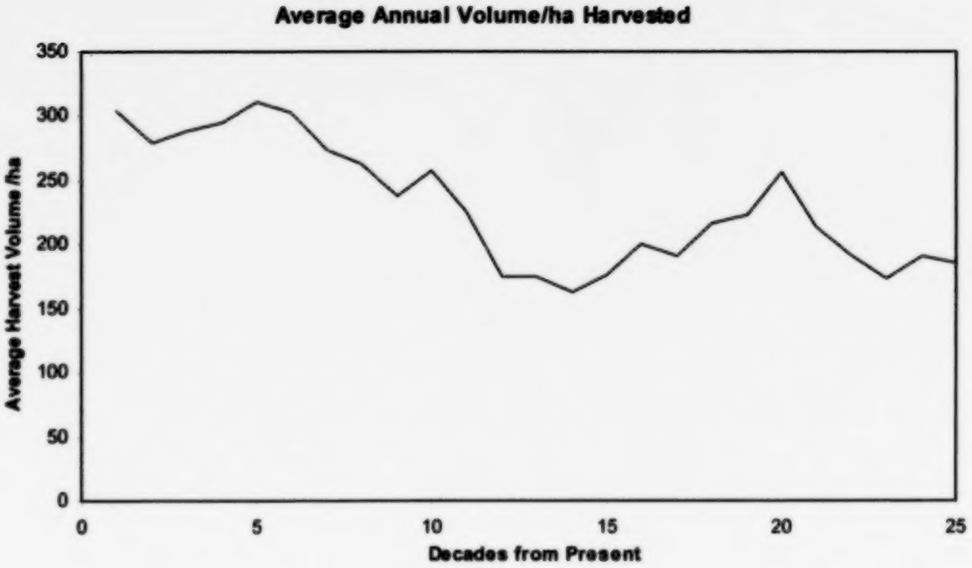

Figure 33. Mean harvest volume/ha for the LRMP base case harvest projection

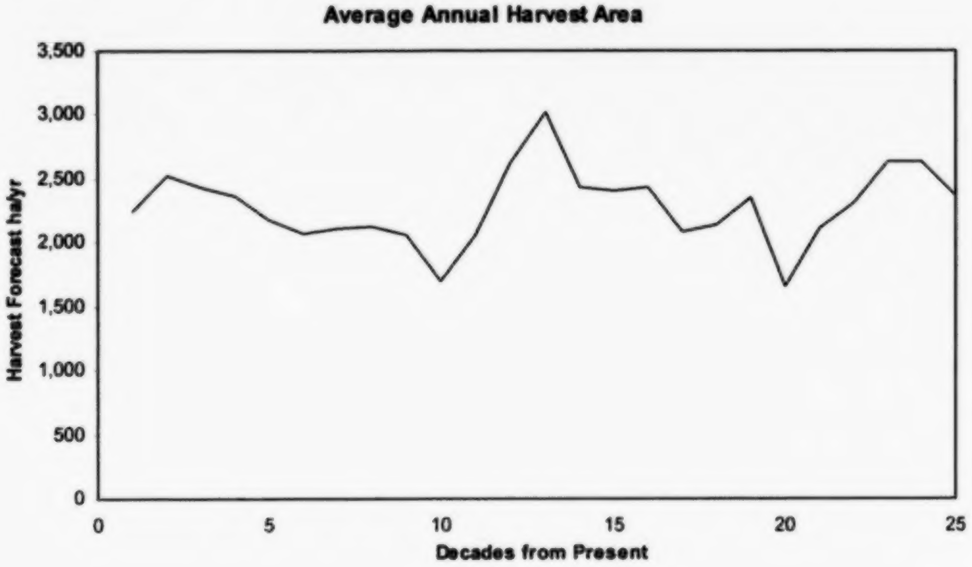

Figure 34. Total harvest area per year for the LRMP base case harvest projection

5.3.3 Age Class Distribution

Figure 35 provides a time-series showing the age-class distribution of the TSA's forest in 50 year increments. The present day stand ages are well distributed over a wide range of age classes, with the most area falling within the 90-160 age classes. The ages on the non-contributing forest are fairly well distributed among all of the age classes but is generally older than the THLB area. The younger age classes are dominantly THLB. Currently, there is very little forest between 30 and 50 years of age on the TSA. By 100 years into the future (just prior to the start of the long-term harvest level), the timber harvesting land base is becoming evenly distributed in the age classes below typical rotation ages (≤120 yrs).

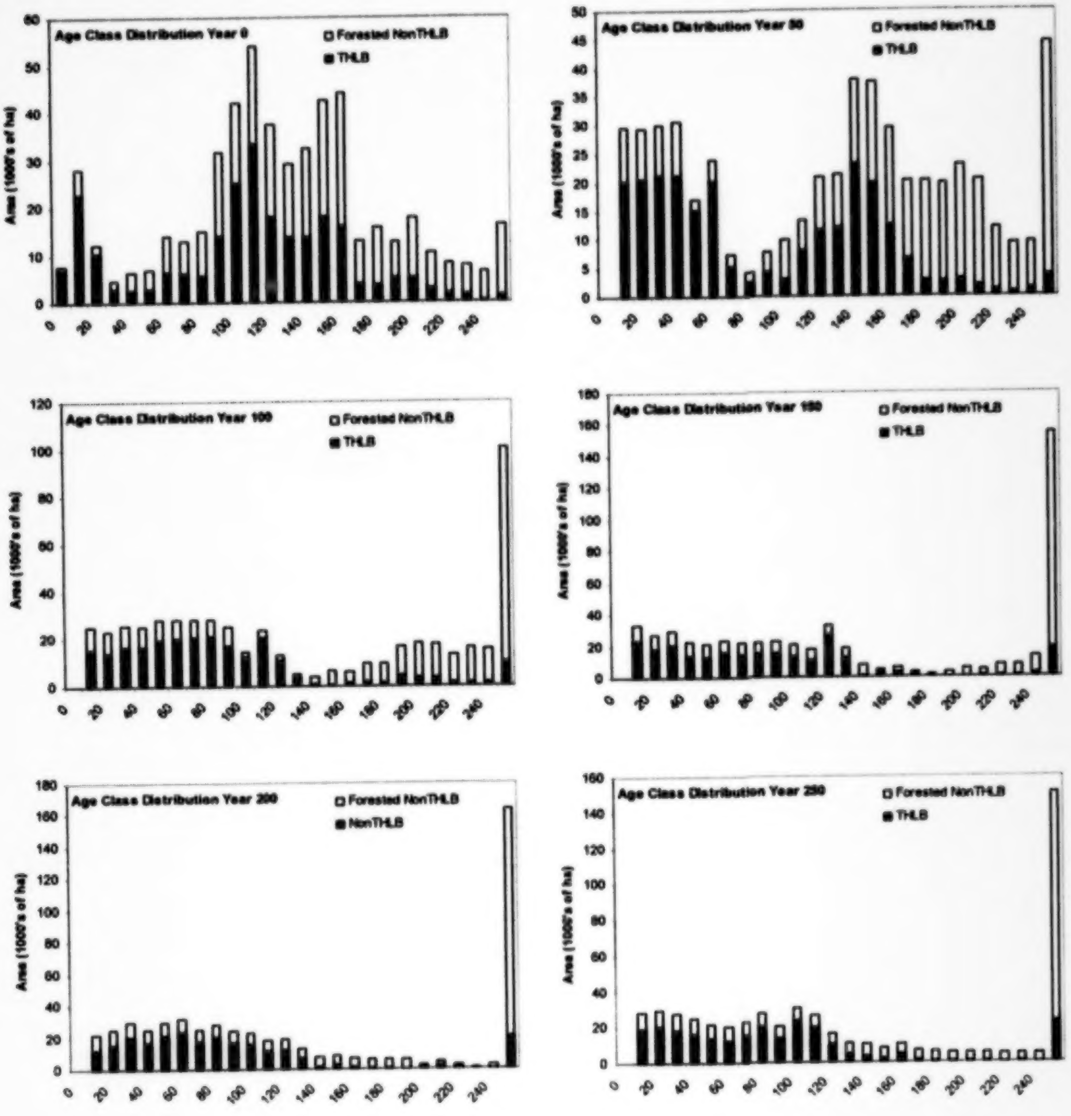

Figure 35. Age class composition of the Lillooet TSA: six snapshots from the base case

The 250 year snapshot shows a relatively even distribution of THLB stands in the 10-120 year age classes with smaller amounts of area in the age classes >130, corresponding with stands with longer rotation ages. Also of note in the 250 year snapshot is that over 32,346 ha of THLB exist in ages over 150 yrs, with the vast majority coming from stands over 250 years old. These are areas of THLB that are constrained to an extent that timber harvesting is prevented (i.e. OGMAs and grizzly bear reserves), and represents over 14.4% of this scenario's long-term timber harvesting land base.

The modeling of natural disturbance in the non-THLB leads to the creation of a relatively even distribution of non-THLB stands through most of the age classes. The 250 year snapshot shows a well-distributed non-contributing land base and a large area of non-contributing that has aged to >250 years old.

5.4 Constraints Analysis

This section of the report expands on the earlier constraints discussion provided for the Current Practice base case (Section 4.4). The issues discussed above remain much the same but additional constraints are added by the LRMP and they are discussed here.

Elk, Moose, Mountain Goat:
The constraints modeled for these three wildlife species were rarely seen to limit harvest from occurring in their respective areas of the TSA during the planning horizon. Very small portions (<2%) of the Moose area did reach threshold levels in the middle of the planning horizon but the Elk and Mountain Goat areas never reached threshold levels and thus did not impact on harvest levels or locations.

Mule Deer Winter Range (MDWR):
MDWR constraints retain a portion of each 'planning cell' in snow interception cover depending on the snowpack rating (shallow or moderate). Shallow snowpack constraints cover 24,579 ha of THLB while moderate snowpack constraints cover 32,412 ha of THLB. The shallow constraints were seen to limit harvesting in 10-15% of its area at the start of the planning horizon and then drop to only limit harvesting in ~5% of the area for the rest of the planning horizon. Moderate snowpack areas have more restrictive cover constraints and limited harvest in ~40% of its area at the start of the planning horizon, while ~60% of the area is limited in the long term. These limitations do not necessarily translate into timber supply impacts if harvest can be implemented elsewhere in the TSA – refer to MDWR Critical Issue analysis (Section 6.3.1).

Grizzly Bear:
Grizzly bear management was modeled as a set of reserves in critical habitat areas throughout the TSA. They prevented harvest from occurring in 7942 ha of THLB in all periods.

5.5 LRMP Base Case Sensitivity Analyses

This section presents the results of sensitivity analyses applied do the LRMP base case. The sensitivity analyses are identical to those done on the current practice base case and presented in Section 4.6 of this document.

5.5.1 Size of Timber Harvesting Land Base

It is not known whether the THLB used in this analysis has been over- or under-estimated, so two sensitivity runs have been completed. These runs increase and decrease the size of the THLB by 10%.

How was It Analyzed?

Run	How was it Analyzed?
Timber harvesting land base + 10%	The size of each THLB polygon was increased by 10%, while the size of NonTHLB polygons were decreased by the corresponding percentage that maintained the correct total land base area. The increased THLB was 267,476 ha in size.
Timber harvesting land base - 10%	The size of each THLB polygon was decreased by 10%, while the size of NonTHLB polygons were increased by the corresponding percentage that maintained the correct total land base area. The decreased THLB was 218,844 ha in size.

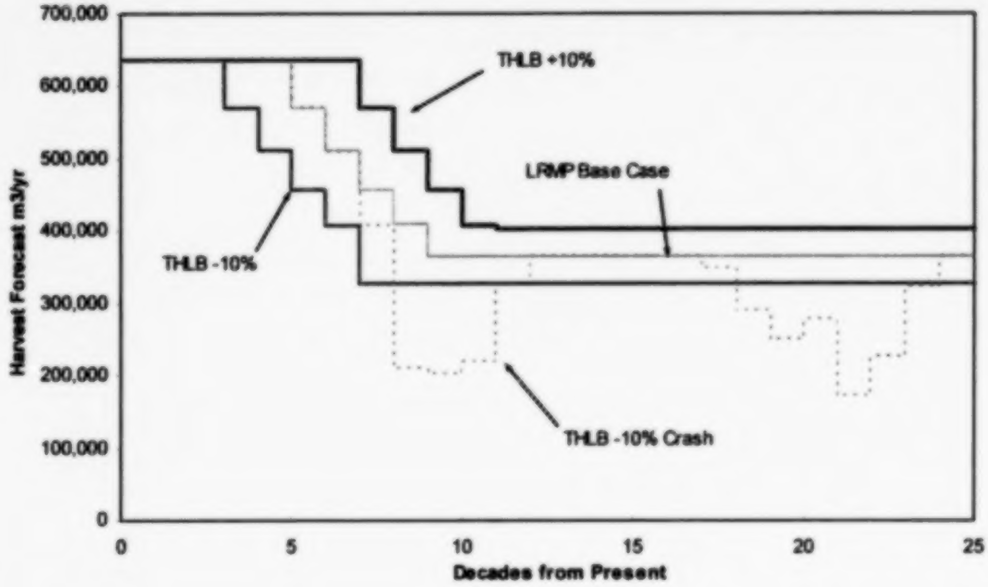

Figure 36. Timber harvesting land base increased and decreased by 10% (LRMP)

Results

Run	Short Term	Mid Term	Long Term
Timber Harvesting Land Base + 10%	The current AAC (635,900 m^3/yr) is maintained for 2 additional decades.	Transition to LTHL occurs 2 decades later.	The LTHL increases 10.6% to 402,920 m3/yr.
Timber Harvesting Land Base - 10%	The current AAC (635,900 m^3/yr) is maintained for 2 fewer decades.	Transition to LTHL occurs 2 decades earlier.	The LTHL decreases 9.9% to 328,420 m3/yr.

5.5.2 Yields from Natural and Managed Stands

It is not known whether the yields used in this analysis has been over- or under-estimated, so four sensitivity runs have been completed. These runs increase and decrease the natural and managed stand yields by 10%.

How was it Analyzed?

Run	How was it Analyzed?
Natural Stands + 10%	The yield associated with each natural stand analysis unit (100 and 1000 series) was increased by 10%.
Natural Stands - 10%	The yield associated with each natural stand analysis unit (100 and 1000 series) was decreased by 10%.
Managed Stands + 10%	The yield associated with each existing managed and future managed stand analysis unit (200, 500, 600 series) was increased by 10%.
Managed Stands - 10%	The yield associated with each existing managed and future managed stand analysis unit (200, 500, 600 series) was decreased by 10%.

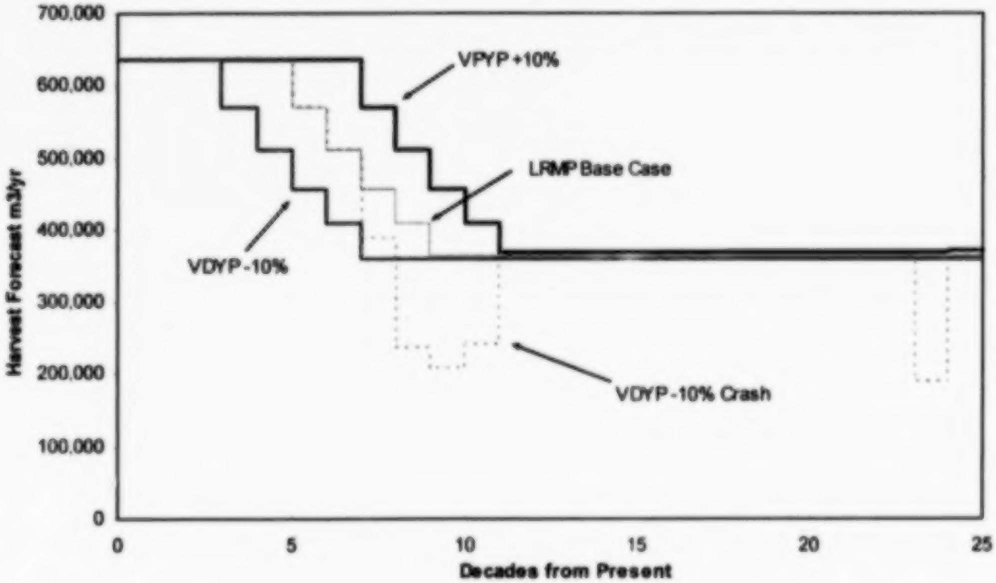

Figure 37. Natural stand yields increased and decreased by 10% (LRMP)

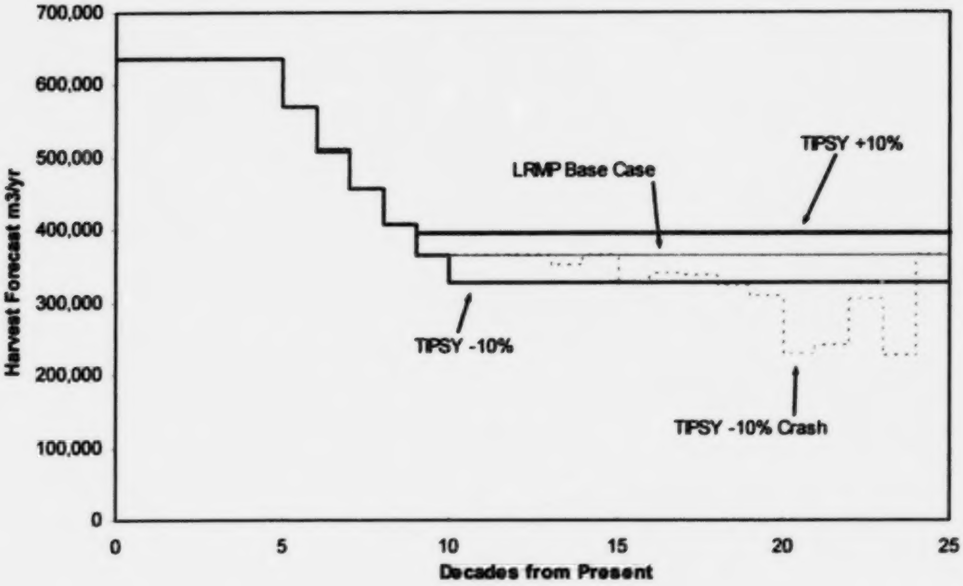

Figure 38. Managed stand yields increased and decreased by 10% (LRMP)

Results

Run	Short Term	Mid Term	Long Term
Natural Stands +10%	Current AAC (635,900 m^3/yr) is maintained for 2 additional decades.	Transition to LTHL occurs 2 decades later.	The LTHL increases by 1.5% to 369,920 m3/yr.
Natural Stands -10%	Current AAC (635,900 m^3/yr) is maintained for 2 fewer decades.	Transition to LTHL occurs 2 decades earlier.	The LTHL decreases by 1.5% to 358,920 m3/yr.
Managed Stands +10%	No change.	No change.	The LTHL increases by 8.9% to 396,920 m3/yr.
Managed Stands -10%	No change.	Transition to LTHL occurs 1 decade later.	The LTHL decreases by 10.2% to 327,420 m3/yr.

Changes to natural stands yields have significant impacts on the length of time the current AAC can be maintained because it is this stock of existing volume that must be metreed out until managed stands come online in significant volumes. Natural (VDYP) yields area also affecting the long term because the drybelt fir stands remain on these curves throughout the analysis and thus contribute more or less volume throughout the planning horizon.

Changes to managed stand yields have no impact in the short term but do have significant impacts in the long term. The scale of the impact is almost directly proportional with the over/under estimation of volume.

5.5.3 Minimum Harvest Ages

It is unknown if there are more appropriate minimum harvest ages than those used in the LRMP base case, so sensitivity runs have been completed to explore the impact of both higher and lower ages.

How was it Analyzed?

Run	How was it Analyzed?
Min Harvest Ages decreased by 10yr	Minimum harvest ages for each AU were decreased by 10 years.
Min Harvest Ages increased by 10yr	Minimum harvest ages for each AU were increased by 10 years.

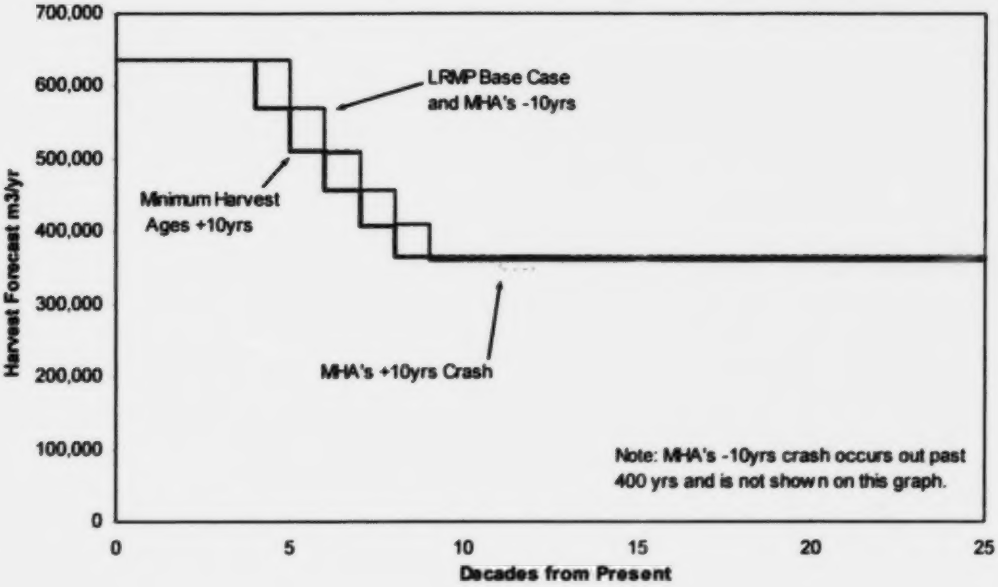

Figure 39. Minimum harvest ages increased and decreased by 10 years (LRMP)

Results

Run	Short Term	Mid Term	Long Term
Min Harvest Ages decreased by 10yr	No change.	No change.	LTHL decreases by 1.2% to 359,920 m3/yr.
Min Harvest Ages increased by 10yr	Current AAC maintained for 1 less decade.	Transition to LTHL occurs 1 decade earlier.	LTHL increases by 0.1% to 364,920 m3/yr.

The LRMP base case forecast is somewhat sensitive to increased minimum harvest ages because it delays the availability of managed stands and forces existing volumes to be metreed out more slowly (e.g. causes fall down to start one decade earlier). The increased harvest age results in managed stands being harvested closer to culmination age and thus slightly increases the long-term harvest level.

The opposite is true when harvest ages are decreased – long term harvests decrease slightly because harvesting is occurring a bit further away from culmination ages. The decrease does not result in any change in the short term because the increased flexibility afforded by reduced ages does not offset the lower volumes achieved.

5.5.4 Harvest Priorities

This harvest priority sensitivity looks at the effect of replacing the relative-oldest-first priority in the base case with an absolute-oldest-first priority. An absolute oldest first rule will select the oldest available stands for harvest first without consideration of minimum harvest ages.

How was it Analyzed?

Run	How was it Analyzed?
Absolute Oldest First	In the timber supply model – the harvest rule was changed to absolute oldest first from relative oldest first.

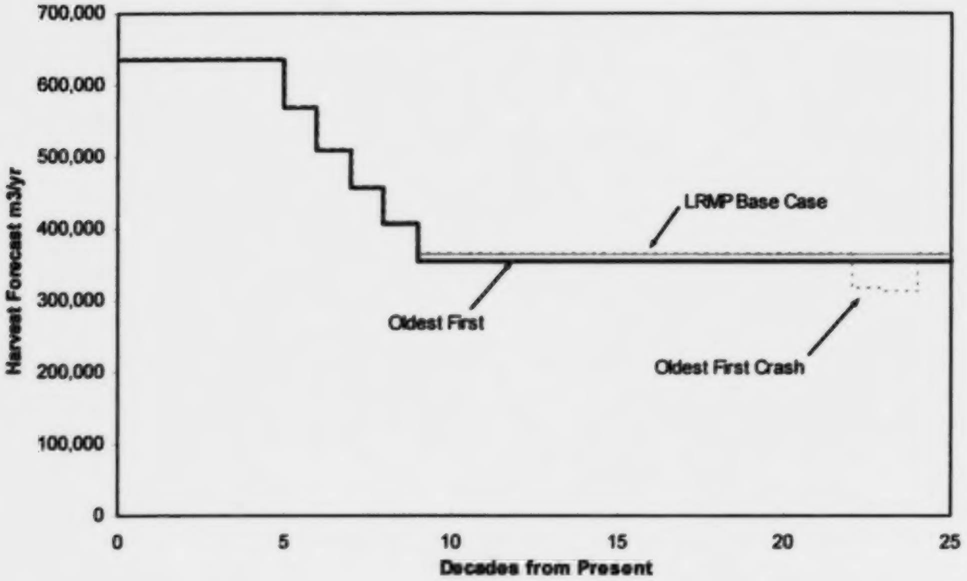

Figure 40. Alternative harvest priorities - random / relative oldest first (LRMP)

Results

Run	Short Term	Mid Term	Long Term
Absolute Oldest First	No change.	No change.	The LTHL decreases by 2.9% to 353,920 m3/yr.

A relative oldest first priority had no impact on the short or mid term harvest forecast but caused a 3% reduction on the long term forecast.

5.5.5 Greenup Ages

Constraints for visual quality, IRM green-up, and community watersheds limit the amount of area that can be under specific heights throughout the planning horizon. Greenup ages are used in the modeling process to indicate the length of time it takes stands to reach these heights. The analyses presented here are designed to explore how sensitive the harvest projections are to the green-up ages used in the LRMP base case.

How was It Analyzed?

Run	How was it Analyzed?
Greenup ages decreased by 5yr	Greenup ages for VQO's, IRM greenup, and community watershed constraints were decreased by 5 yrs
Greenup ages increased by 5yr	Greenup ages for VQO's, IRM greenup, and community watershed constraints were increased by 5 yrs

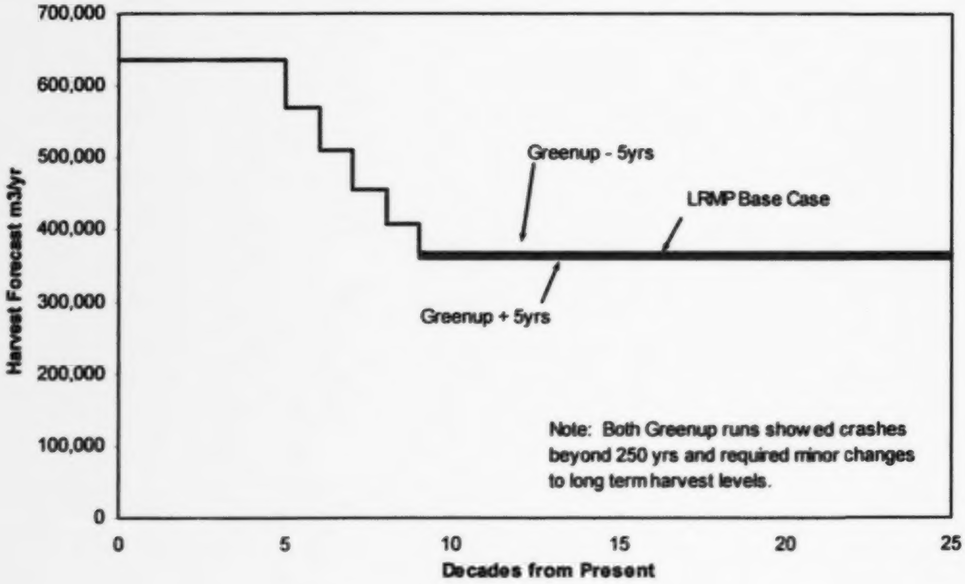

Figure 41. Alternative greenup times for VQOs, IRM greenup, and CWSs (LRMP)

Results

Run	Short Term	Mid Term	Long Term
Greenup ages decreased by 5yr	No change.	No change.	LTHL increases by 0.7% to 366,920 m3/yr.
Greenup ages increased by 5yr	No change.	No change.	LTHL decreases by 1.0% to 360,920 m3/yr.

The short and midterm harvest projections are not sensitive to green-up ages but the long-term harvest level fluctuates by approximately 1% under the two scenarios. Longer green-up ages result in less timber available for harvest per year while shorter green-up ages allow for more flexibility in harvest scheduling. The scale of the change in these analyses indicates that green-up times are not a major influencing factor in this TSA.

6.0 Critical Issue Analyses (Current Practice Base Case)

There are a number of issues present in the Lillooet TSA that could influence or impact future timber supply. An understanding of these issues also helps to understand the current timber supply projections. These issues are explored in this section and cover the following topics:

- Inventory Adjustments;
- Site index adjustment for managed stands;
- Individual LRMP issues;
- Varying economic climates on the THLB area;
- Potential contribution of PA16;
- Disturbing the NonTHLB; and
- Meeting old seral objectives with seral constraints instead of spatial OGMAs.

6.1 Exclude Inventory Adjustment

The natural stand yield curve (VDYP) volumes used in the base case were adjusted to reflect VRI phase 2 ground sampling as described in section 3.10.1 of Appendix B. This analysis explores the impacts of eliminating the adjustment from these yield estimates. The 100 series AU yield curves were adjusted based on Volume Impact Ratios calculated for each AU. Details are provided below under "How was it Analyzed?" and in Table 6 below. Across the entire THLB, the original adjustment increased volumes by 12.4%, thus reversing this adjustment required a 11.03% (1 - 1/1.124) reduction to the current volume. Managed stand (TIPSY) yield curves were not altered even though the site indexes used to build these curves were affected by the adjustment process. It is recognized that the long term harvest level is overestimated in this analysis relative to what would be achieved if no adjustment process was undertaken.

Table 6. Impact Ratios for TSR3 Analysis Units[2]

AU No.	Analysis Unit	Adjusted Inventory Vol (m3)	Unadjusted Inventory Vol (m3)[1]	AU Volume Impact Ratio[2]
101	Nat - Fd Drybelt Selection <141	1,655,443	2,074,490	0.798
102	Nat - Fd Drybelt Selection 141+	2,030,796	2,521,760	0.805
103	Nat - Fd Wetbelt Good/Med <141	985,915	739,016	1.334
104	Nat - Fd Wetbelt Good/Med 141+	419,289	533,446	0.786
105	Nat - Fd Wetbelt Poor <141	4,996,566	3,742,769	1.335
106	Nat - Fd Wetbelt Poor 141+	5,874,553	7,473,273	0.786
107	Nat - Sx/Bl/Cw/Hw Good/Med <141	2,483,785	1,739,401	1.428
108	Nat - Sx/Bl/Cw/Hw Good/Med 141+	1,346,411	942,865	1.428
109	Nat - Sx/Bl/Cw/Hw Poor <141	3,008,413	2,106,732	1.428
110	Nat - Sx/Bl/Cw/Hw Poor 141+	6,696,011	4,689,084	1.428
111	Nat - Pl Good/Med <101	607,689	476,573	1.275
112	Nat - Pl Good/Med 101+	2,428,273	2,147,014	1.131
113	Nat - Pl Poor <101	1,667,287	1,307,529	1.275
114	Nat - Pl Poor 101+	12,837,983	11,350,804	1.131
Total THLB		**47,038,416**	**41,844,755**	**1.124**

[1] Sum of polygon specific volumes adjusted using Impact Ratios defined in Appendix B section 3.10.1 for sampling stratums.
[2] Volume impact ratio represents the overall volume impact of the set of adjustments (age, height and volume)

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[2] Based on "Lillooet Forest District VRI Statistical Adjustment Addendum, April 2003" and Karen Jahraus' July 14/04 spreadsheet provided by Lloyd Wilson)

How was it Analyzed?

Run	How was it Analyzed?
Remove Inventory Volume Adjustment	1. Impact Ratios from the VRI Phase 2 adjustment project were assigned to all polygons in the dataset based on the adjustment project's stratum criteria. 2. A 'non-adjusted' total volume for each polygon was then calculated by dividing the current total inventory volume (adjusted) for each polygon by its impact ratio. 3. The 'non-adjusted' volumes were then totaled for the THLB by AU and compared to adjusted volumes. These two values provided the Impact Ratio for each AU (see Table 6). 4. VDYP yield curve (100 series AUs) were adjusted according to the Impact Ratio determined for each AU (AU volumes were divided by the Impact Ratio specific to that AU).

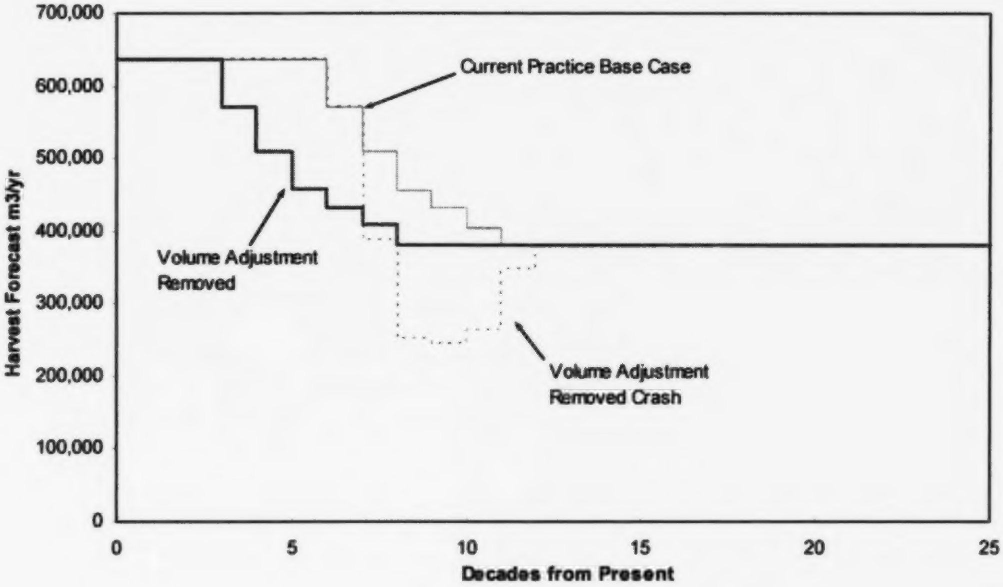

Figure 42. Removal of inventory volume adjustment

Results

Run	Short Term	Mid Term	Long Term
Volume Adjustment Removed	30 Yr less of AAC	Transition to the long term level occurs sooner (9th decade).	No Change (371,920 m3/yr)

The reduction in initial growing stock on the THLB resulted in a reduction in the time the current AAC could be sustained and thus shifted the transition to the long term harvest level forward. The long term harvest level remained unchanged, although it is recognized that a full removal of the adjustment process would have reduced the LTHL (generally lower site indexes passed to TIPSY curves).

6.2 Site Index Adjustment for Managed Stands

Throughout the province, it has been recognized that existing inventory site indexes often do not adequately reflect the potential stand growth experienced by second growth, managed stands. Current site productivity estimates are based on the existing inventory of natural stands - stand ages and heights are used to derive site indexes for each stand. These heights and ages are often underestimate site index for older stands because of issues such as repression, suppression, stand damage, or general inaccuracies in determining old stand ages.

In an effort to understand the potential impact of applying an ecologically based site index adjustment in Lillooet, a sensitivity run was completed where all managed stand curves were built using site indexes adjusted based on ecological relationships (SIBEC). This site index adjustment was not included in the base case scenario because the accuracy of the underlying ecosystem map is unknown.

The adjustment process increased the average site index on the THLB from 13.1m to 14.8m (1.7m or 13.1% increase). The difference by BEC zone can be seen in Figure 43 while the source for SI estimates is shown in Figure 44. The IDF makes up the largest area of the THLB and has the largest gain of the three main BEC zones. Figure 44 indicates that 1st approximation SIBEC values were often used because 2nd approximation value were not available. At the land base level, inventory SI values / 1st Approx SIBEC / 2nd Approx SIBEC values were used on 26% / 58% / 16% of the THLB respectively.

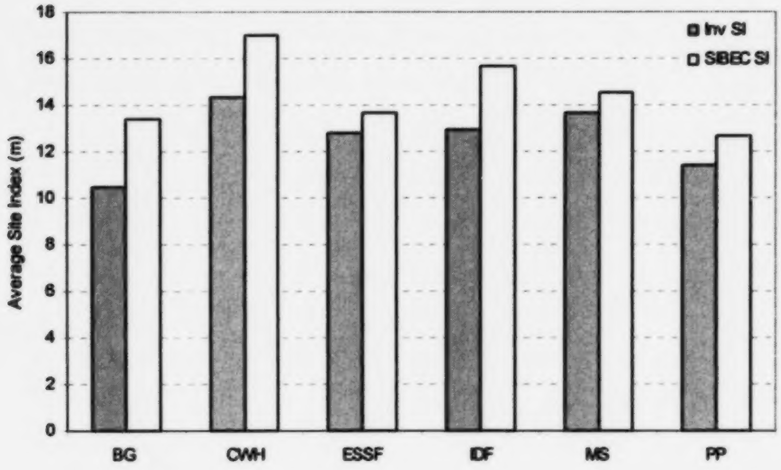

Figure 43 . Inventory and SIBEC adjusted average site indexes by BEC variant

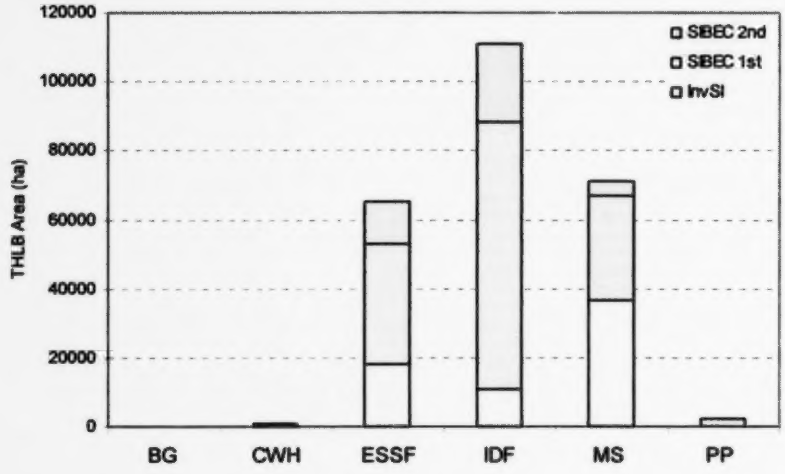

Figure 44. THLB Area by BEC and SIBEC Source

How was it analyzed?

Run	How was it Analyzed?
SIBEC Adjusted Site Indexes	The Lillooet PEM was used to derive new site index estimates for the TSA based on provincial SIBEC relationships. Because of the number of new BEC variants in the TSA, crosswalk tables were used to assign SIBEC values whenever possible (as provided in PEM documentation). The new site indexes were used to derive changes to future stand yields (new TIPSY yields), changes to green-up ages (reduced 1-2 yrs) and changes to minimum harvest ages (generally reduced).

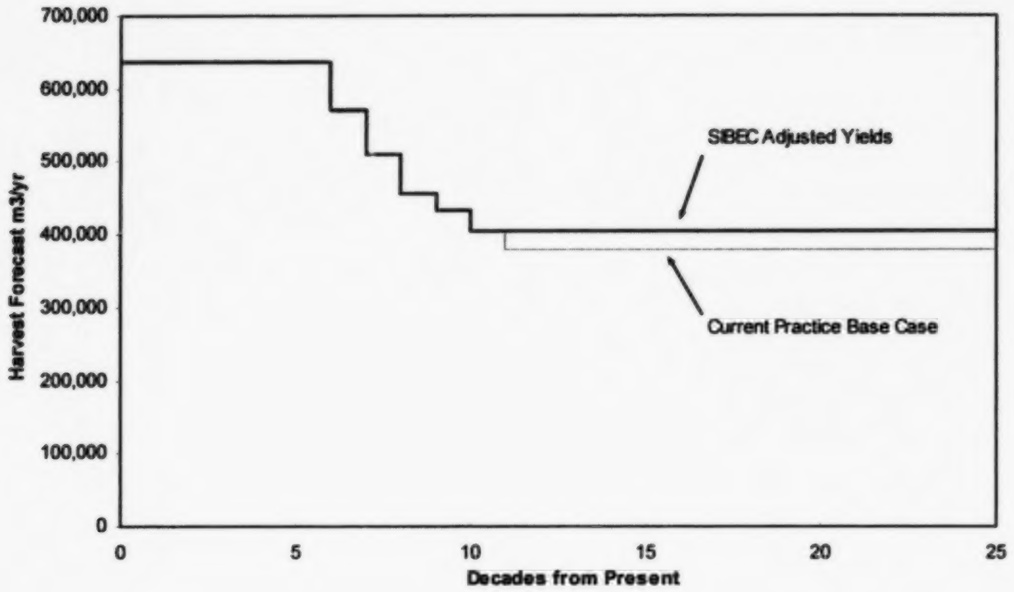

Figure 45. Site productivity estimates for managed stand yields adjusted using SIBEC.

Results

Run	Short-term	Mid Term	Long-term
SIBEC Estimates	No change.	Transition to LTHL occurs a decade earlier.	LTHL is 6.9% higher. (405,920 m3/yr)

The transition to the long-term harvest level is able to occur a decade earlier because managed stands come online earlier (lower minimum harvest ages) and typically with more volume/ha. The long term harvest level increases by 6.9% as a result of the increased productivity of the managed stand portion of the land base. The faster growth of stands also means that green-up heights are achieved sooner.

It should be noted that this scenario would have shown a larger increase in the long term harvest level prior to the adjustment of the forest cover inventory file. This adjustment served to increase the site indexes on the THLB as a whole and thus the impact of the SIBEC adjustment was reduced.

6.3 LRMP Issues

6.3.1 Mule Deer Winter Range

The LRMP guidelines for Mule Deer Winter Range (MDWR) specify a 6000 ha THLB planning allowance to capture the impacts associated with maintaining snow interception cover within key habitat areas. For purposes of modeling, MDWR planning cells were created (200-800 ha in size) and cover constraints were applied to the CFLB area of each one based on snowpack rating:

- Shallow snowpack: 15% snow interception required (minimum of 15%> 140 yrs). Shallow snow pack constraints are applicable to 66,180 ha of CFLB (24,579 ha of which is THLB).

- Moderate snowpack: 33% snow interception required (minimum of 33% > 140 yrs). Moderate snow pack constraints are applicable to 58,955 ha of CFLB (32,415 ha of which is THLB).

How was it analyzed?

Run	How was it Analyzed?
LRMP MDWR added to current base case	MDWR cover constraints were added to the current practice base case. Based on snowpack rating, constraints were applied to the CFLB area of each MDWR planning cell individually (200-800 ha in size). See Appendix B section 7.6.7 for more detail.

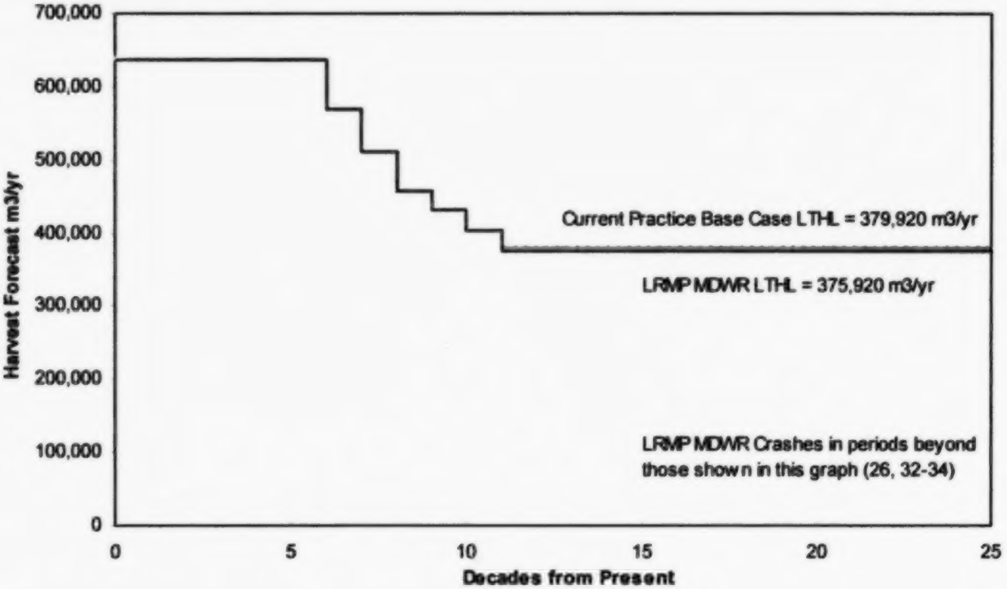

Figure 46. Harvest projection when LRMP MDWR is implemented in the current practice base case.

Results

Run	Short-term	Mid Term	Long-term
LRMP MDWR added to current base case	No change.	No Change	LTHL drops by 1% to 375,920 m3/yr.

Although there is substantial area affected by the addition of this constraint (22.7% of THLB) and the constraints are not insignificant, there is little impact seen on the TSA harvest projection. This appears to be because of the high degree of overlap with other issues already maintaining older stands on the land base (CWS, VQO's, OGMAs) and the significant area of NonTHLB within the MDWR areas. On average, 54% of each MDWR planning cell is made up of NonTHLB area that can contribute toward meeting the cover objective. This scenario does not perfectly replicate what would be considered appropriate on the ground because only age is considered when identifying suitable snow interception cover areas. A preference would be given to Douglas-fir leading stands in operational practice.

6.3.2 LRMP Elk, Moose, and Mountain Goat

The LRMP identifies specific habitat requirement for Elk, Moose and Mountain goat.

- Elk habitat areas are to have no more than 33% of the CFLB under 3m tall (~21 yrs) and at least 30% of the CFLB over 16m tall (~81 yrs). Elk habitat constraints are applicable to 4% of the CFLB and THLB (10,162 ha of THLB). See Appendix B Section 7.6.4 for more detail.
- The broad moose habitat areas under the LRMP do not have any cover constraints that can be modeled, but the high value sites designated as Moose Management Units (MMUs) are to have at least 67% of the CFLB over 4m tall (~20 yrs). MMU's occur on 3% of the CFLB and THLB (8,474 ha of THLB). See Appendix B Section 7.6.5 for more detail.
- For mountain goat, escape terrain within wintering/kidding areas are to have no more than 33% of the CFLB under 40 yrs old and at least 50% of the CFLB over 100 yrs old. These areas occupy 2% of the CFLB and 1% of the THLB (1,413 ha of THLB). See Appendix B Section 7.6.6 for more detail.

Each of these LRMP requirements was added to the current practice base case individually to explore implications on TSA level harvest projections.

How was it analyzed?

Run	How was it Analyzed?
LRMP Elk LRMP Moose LRMP Mtn Goat	The seral constraints relevant to each issue were individually added to the current practice base case. See Appendix B sections 7.6.4 to 7.6.6 for detail on the constraints applied.

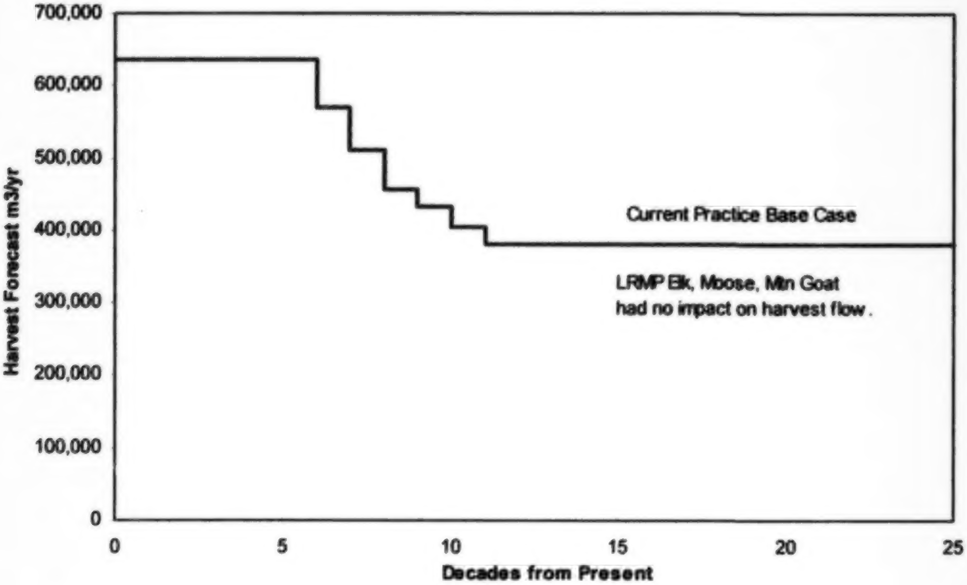

Figure 47. Harvest projection when LRMP Elk/Moose/Mtn Goat added to current practice base case.

Results

Run	Short-term	Mid Term	Long-term
LRMP Elk LRMP Moose LRMP Mtn Goat	No change.	No change	No change

As intended by the LRMP, the seral constraints applicable to these wildlife species did not impact on overall harvest flow. However, they occasionally did influence where and when harvest occurred in the TSA. These constraints are either not significant when economic rotation ages are considered, apply to small areas of the land base, or have substantial areas of forested NonTHLB available to help meet the constraint.

6.3.3 LRMP Grizzly

The LRMP specifies an 8000 ha THLB allowance for management of grizzly bears. This allowance is to be used to reserve key habitat features from logging and recognize reduced levels of productivity in areas where reduced stocking / cluster planting will be implemented. For purposes of modeling, 7942 ha of critical habitat was selected from the current practice THLB using habitat capability mapping derived from broad ecosystem mapping (see Appendix B section 7.6.2 for more detail). This area was reserved from harvest and the implications on TSA level harvest projections are shown below.

How was it analyzed?

Run	How was it Analyzed?
LRMP Grizzly	An area of 7942 ha of current practice THLB was identified as grizzly bear reserve areas and harvest was prevented from occurring in these areas. This is equivalent to a 1.8% THLB area reduction.

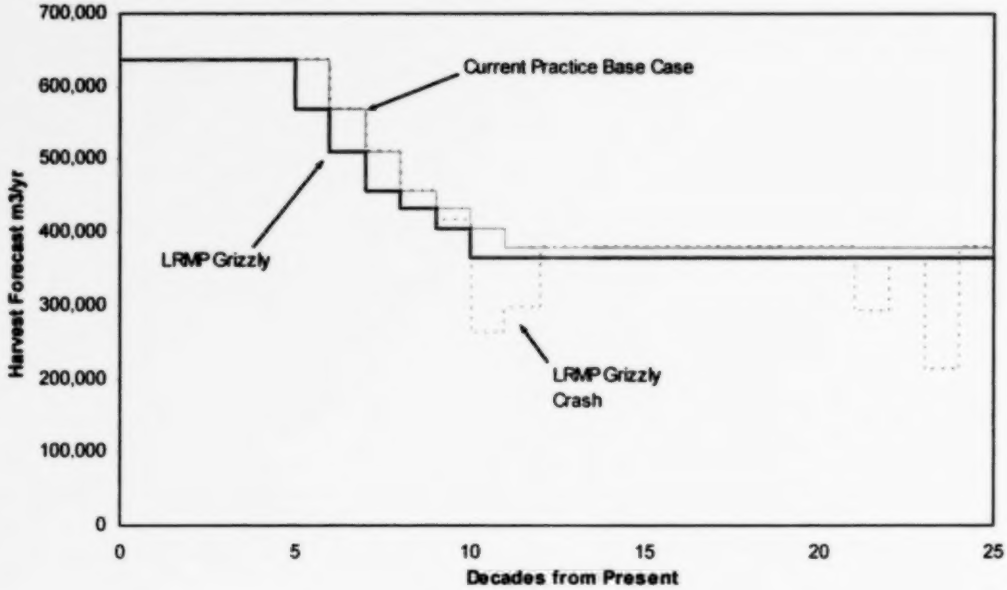

Figure 48. Harvest projection when LRMP Grizzly added to current practice base case.

Results

Run	Short-term	Mid Term	Long-term
LRMP Grizzly	No change	Transition to LTHL occurs one decade earlier	LTHL drops by 3.9% to 364,920 m3/yr.

Although the area removed for grizzly reserves was only 1.8% of the THLB, it resulted in a 3.9% decrease in the long term harvest level. This result occurs at least partially because of the higher than average site indexes within these reserves (14.6m vs 13.1 for the entire THLB). In addition, very little of the grizzly reserve areas currently overlap with OGMAs (8%) or visual management areas so they would have been relatively unencumbered during the base case harvest projection.

6.3.4 LRMP Spotted Owl

Spotted owl was represented in the current practice base case using cover constraints ensuring stands older than 100 and 140 years were both maintained in the Long Term Activity Centers (LTAC's). The management constraints specified for spotted owl under the LRMP simplify the constraints to only ensure stands over 100 yrs were maintained (see Appendix B section 7.6.3 for details). The analysis presented below explores the implications of this change on TSA harvest levels.

How was it analyzed?

Run	How was it Analyzed?
LRMP Spotted Owl	The spotted owl constraint was simplified to require 67% of the CFLB in each LTAC to be older than 100yrs at all time (requirement for 50%>140 yrs was dropped).

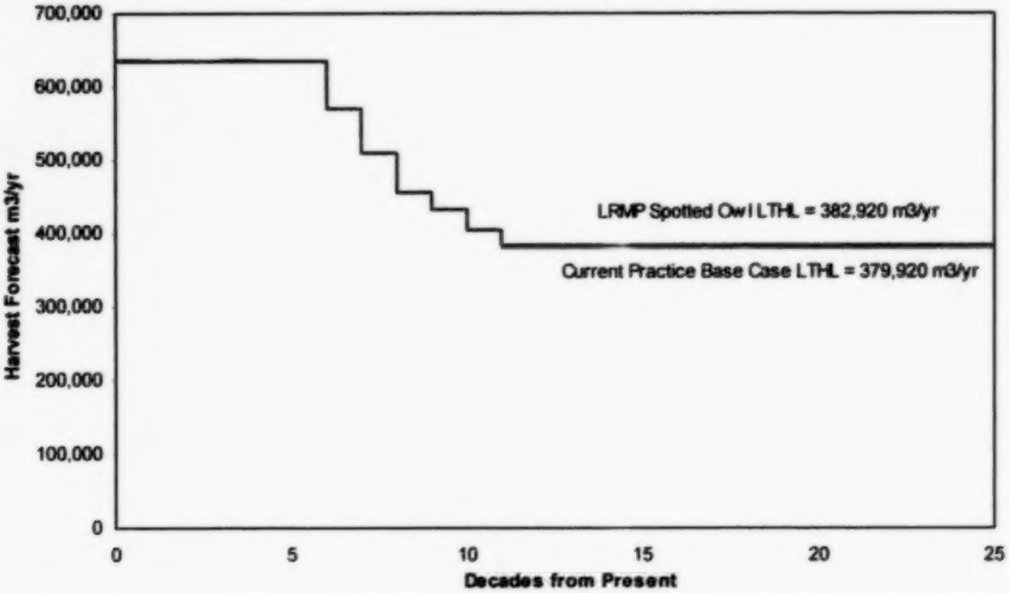

Figure 49. Harvest projection when LRMP Spotted Owl is used in Current Practice base case.

Results

Run	Short-term	Mid Term	Long-term
LRMP Spotted Owl	No change	No change	LTHL increases by 0.8% to 382,920 m3/yr.

The reduced cover constraint has very little impact on the projected harvest flow – only the long term level increases (0.8%). This occurs because the area impacted is not large (8459 ha of THLB) and the constraint that was removed was having very little impact on long term harvest levels in the base case. Earlier constraint analysis (Section 4.4) indicated that the 50%>140 yr constraint was often limiting harvest from occurring in the LTAC's in the short term but in the long term, the 67%>100 yr old constraint was maintaining these stands anyways. The removal of the constraint did not affect short term harvest levels because of the large supply of currently mature timber in the TSA – harvest was simply moved from the LTAC's to other locations.

6.3.5 LRMP Visuals

Visual management under the LRMP utilizes the same set of management polygons currently in use with a few minor changes and some additional areas added along the Fraser River. Each of the polygons is classified as either Zone A or B and only the Zone A polygons are managed as scenic areas under the Forest and Range Practices Act. The Zone B areas will strive for good visual design but will not be considered scenic areas. Thus the LRMP visual management policy is less restrictive than current practice. The area where maximum disturbance constraints are applied under the LRMP represents a 30% reduction in CFLB area and a 33% reduction in THLB area over the current practice base case (see Appendix B section 7.3 for details). The analysis presented below explores the implications of this change on TSA harvest levels.

How was it analyzed?

Run	How was it Analyzed?
LRMP Visuals	The LRMP Zone A VQO polygons were used in place of the current practice VQO polygons. The same maximum disturbance constraints used in the current practice base case were applied to the CFLB portion of each VQO polygon based on the LRMP VQO and VAC rating.

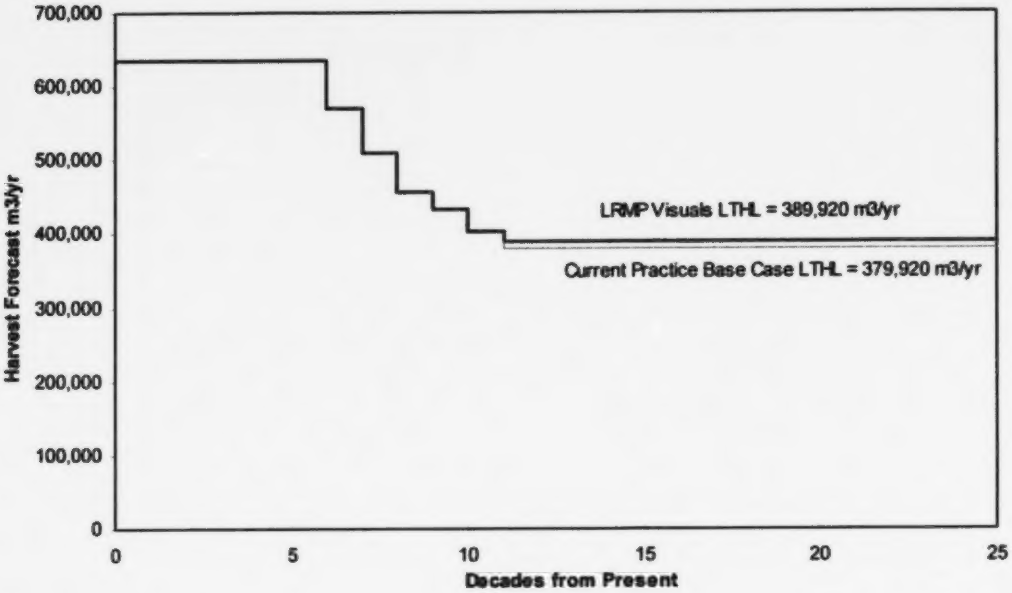

Figure 50. Harvest projection when LRMP visuals replace current practice base case visuals.

Results

Run	Short-term	Mid Term	Long-term
LRMP Visuals	No change.	No Change	LTHL increases by 2.6% to 389,920 m3/yr.

The reduction in THLB area impacted by visual constraints (22,116 less ha) allows a slightly higher harvest level in the long term because those areas no longer under visual management can be managed on rotations ages closer to culmination age. Earlier sensitivity analysis indicated that visual greenup did not have any influence on short term harvest levels and the same result is seen here.

6.3.6 LRMP Parks

Numerous new parks will be created if the LRMP is finalized. This analysis examines the impacts of removing these areas from the THLB. Section 2.4.1 in Appendix B provides details on the parks and their areas. In general, the gross area of parks in the TSA would increase by 25,567 ha and would remove 7,276 ha of THLB from the land base.

How was it analyzed?

Run	How was it Analyzed?
LRMP Parks	The areas associated with the LRMP parks was removed from the current practice base case THLB. This resulted in a THLB reduction of 7276 ha or 1.6%.

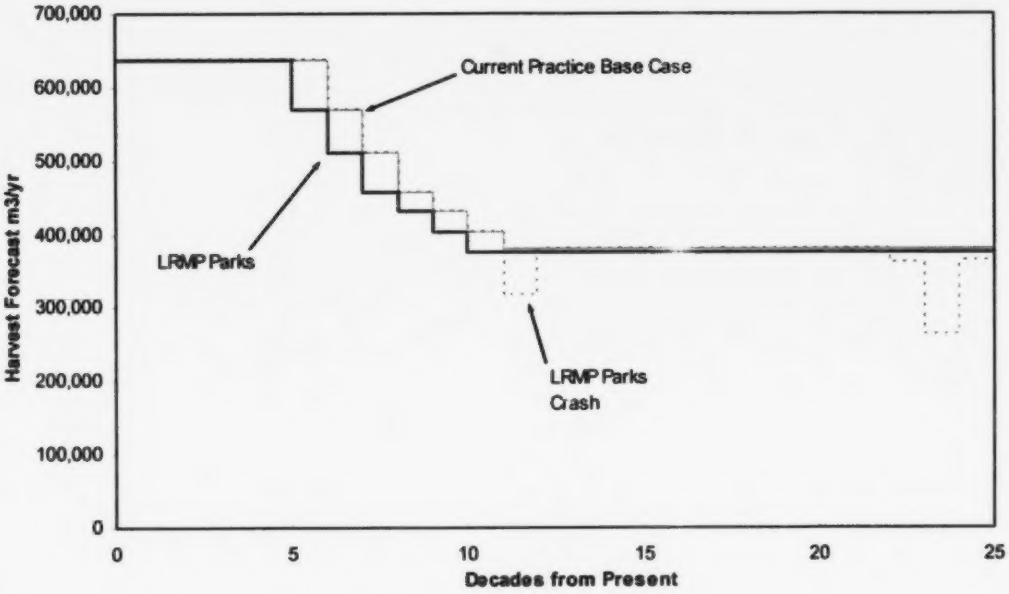

Figure 51. Harvest projection when LRMP Parks added into the current practice base case.

Results

Run	Short-term	Mid Term	Long-term
LRMP Parks	No change.	Transition to LTHL occurs one decade earlier.	LTHL drops by 1.3% to 374,920 m3/yr.

Although the area is similar to the THLB lost to Grizzly bear under the LRMP, the effective loss is much less because of the large degree of overlap with OGMAs (45%) / visual areas / CWS's and the generally lower average site productivity of these sites. The average SI of the THLB area removed was 12.3m for LRMP Parks, while it was 14.6m for the grizzly reserves.

6.4 Economic Operability

As part of the Lillooet TSA's Timber and Economic Recovery Plan (TERP) project, the licensees of the TSA evaluated stands for short term economics under two market conditions (low and high). Each stand in the TSA was assigned a value based on species and expected product recovery (peeler, sawlog, pulp), and a cost based on expected harvesting, hauling, and silviculture costs. The difference between these values (value – cost) represented the net value for the stand and thus defined whether or not it would be economic to harvest.

All of the THLB stands in the current practice base case are considered economic for harvest under fluctuating market conditions for log products (i.e. high, moderate, and low markets all occur). The analyses presented in this section explore how perpetual low or moderate market conditions could impact the size of the THLB and associated harvest levels. The market condition assumptions are shown in Table 7.

Table 7. Market Condition Assumptions by Product[3]

	Product Values ($/m3)		
Market Condition	Peeler	Sawlog	Pulp
Low	$78-$88	$45-$50	$30
Moderate	$92-$112	$60-$70	$40
High	$105-$135	$85-$90	$50

Based on perpetual low or moderate market assumptions, specific stands in the base case THLB were identified as uneconomic. For each market condition, uneconomic stands were removed and a new THLB area was determined (see Table 8).

Table 8. Alternative economic land base definitions[4]

Economic Zone	Current Practice THLB	Low Market Land Base	% Current Practice THLB	Mod Market Land Base	% Current Practice THLB
Antoine	4,896	4,896	100%	4,896	100%
Bonanza	2,824	751	27%	1,647	58%
Botanie	14,162	11,086	78%	12,692	90%
Bridge	3,139	2,644	84%	2,644	84%
Camoo	7,552	5,774	76%	6,675	88%
Cayoosh	8,729	6,447	74%	7,079	81%
Enterprise	2,940	2,246	76%	2,805	95%
Fountain	11,671	3,464	30%	7,169	61%
Gun Lake	8,277	7,634	92%	7,914	96%
Hurley	5,112	4,457	87%	4,927	96%
Junction	7,090	836	12%	3,350	47%
Kwoiek	8,896	3,745	42%	5,336	60%
Lakes	5	5	100%	5	100%
Leon	20,396	15,584	76%	17,211	84%
Lost Valley	3,066	124	4%	341	11%
Marshall	3,825	1,757	46%	2,768	72%
McGillivray	3,364	1,530	45%	2,505	74%
McParlon	4,650	2,537	55%	3,971	85%
Murray	16,258	13,788	85%	14,943	92%
Nicoamen	10,335	7,700	75%	8,509	82%
Noaxe	18,035	13,195	73%	14,339	80%
Noel/Cadwallader	6,987	6,987	100%	6,987	100%
North Carpenter	1,795	1,151	64%	1,499	84%
North Seton	365	365	100%	365	100%
Pavilion A	10,178	8,598	84%	9,104	89%
Pavilion B	2,146	2,146	100%	2,146	100%
Shulaps	5,861	3,957	68%	4,567	78%
Siwhe	2,115	53	3%	76	4%
Slim	1,479	794	54%	984	67%
Soap	2,361	1,960	83%	1,972	84%
South Carpenter	4,125	202	5%	359	9%
South Seton	2,060	181	9%	182	9%
Stein	93	93	100%	93	100%
Texas	7,402	1,078	15%	1,819	25%
Tommy	3,083	102	3%	279	9%
Upper Bridge	2,959	1,217	41%	2,483	84%
Upper Yalakom	4,564	1,362	30%	3,245	71%
Watson Bar	24,862	5,569	22%	6,491	26%
Whitecap	2,771	2,359	85%	2,611	94%
Totals	**250,426**	**148,378**	**59%**	**176,989**	**71%**

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[3] As provided by Timberline Forest Inventory Consultants, March 21, 2005. (Source data last revised March 4, 2003)

[4] Derived using Timberline data indicating which economic zone / AU / slope class combinations were considered uneconomic.

Under a perpetually low market condition, only 148,378 ha or 59% of the current THLB would appear viable. Under a perpetually moderate market condition, only 176,989 ha or 71% of the current THLB would appear viable. Table 8 provides a summary of the land base changes by geographic areas in the TSA. Areas with large differences in THLB under different market conditions have the most challenging economic conditions.

How was it analyzed?

Run	How was it Analyzed?
Perpetual Low Market Land Base	Areas identified uneconomic under low market conditions were removed from the Current Practice THLB (102,048 ha removed / 41% reduction in THLB area).
Perpetual Moderate Market Land Base	Areas identified uneconomic under moderate market conditions were removed from the Current Practice THLB (73,437 ha or 29% reduction in THLB area).

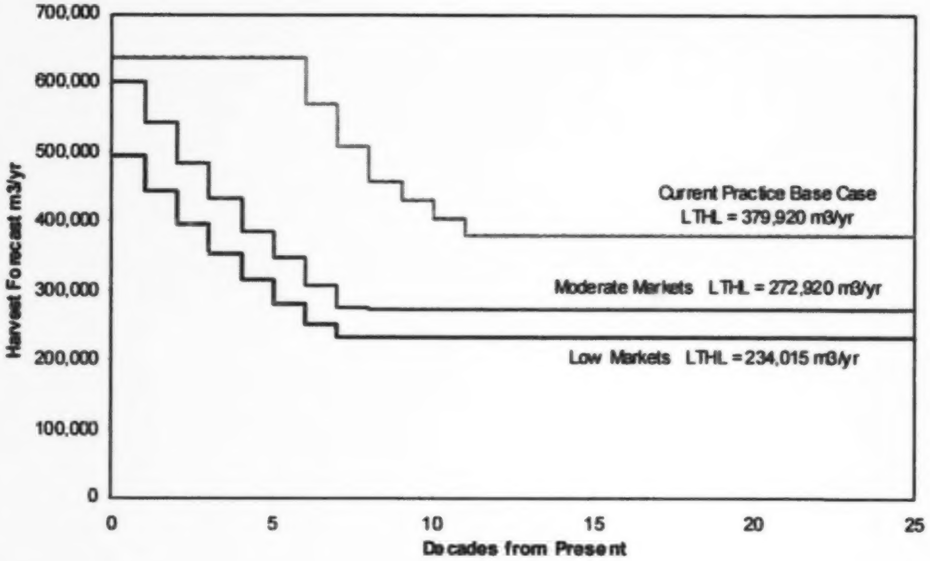

Figure 52. Harvest projection given different market conditions.

Results

Run	Short-term	Mid Term	Long-term
Perpetual Low Market Land Base	Initial harvest level drops by 22% to 493,920 m^3/yr.	LTHL reached in 8th decade.	LTHL drops by 48% to 234,015 m3/yr.
Perpetual Moderate Market Land Base	Initial harvest level drops by 5% to 604,020 m^3/yr	LTHL reached in 8th decade	LTHL drops by 28% to 272,920 m3/yr.

The elimination of high market cycles severely impacts the size of the economic land base and therefore the harvest flow from the TSA. There is a significant area of stands that only become economic under high market conditions as seen by the difference between the base case harvest flow and the moderate markets harvest flow. May of the stands that are uneconomic under low markets remain uneconomic under moderate markets - it is only at high markets that these stands become available. These stands tend to be on steeper terrain (cable harvest) in the more remote locations of the TSA.

6.5 Pulpwood Agreement 16

Pulpwood Agreement 16 (PA16) has the potential to contribute 25,000 m3 of annual harvest volume in the TSA until 2015 when the agreement expires. The stands associated with PA16 were excluded from the THLB in the current practice base case because there has been no harvest history to date in these traditionally non-merchantable stands. This analysis explores a scenario where 25,000 m3/yr is logged from these sites for a period of 10 years and any area logged remains in the THLB for the duration of the planning horizon.

Area statistics for PA16:	Gross Area of PA16	215,492 ha
	CFLB Area of PA16	151,679 ha
	Area not in current THLB	67,245 ha
	Non merch/Low site netdown area in PA16	39,749 ha
	Stands meeting PA16 AU criteria (age, ht)[5]	29,963 ha

How was it Analyzed?

Run	How was it Analyzed?
Inclusion of PA16	The area associated with PA16 stands (29,963 ha) was included in the THLB and assigned to the 800 series AU's. Random disturbance of the NonTHLB was eliminated from these areas because they are now in the THLB. Harvest was prioritized into the 800 series AU's to a cap of 25,000 m3 per year (~195 ha/yr). The harvest level was increased by 25,000 m3/yr for one period (10 yrs). Any of the PA16 stands logged during this time remained in the THLB, while all others were excluded from harvest for the duration of the planning horizon.

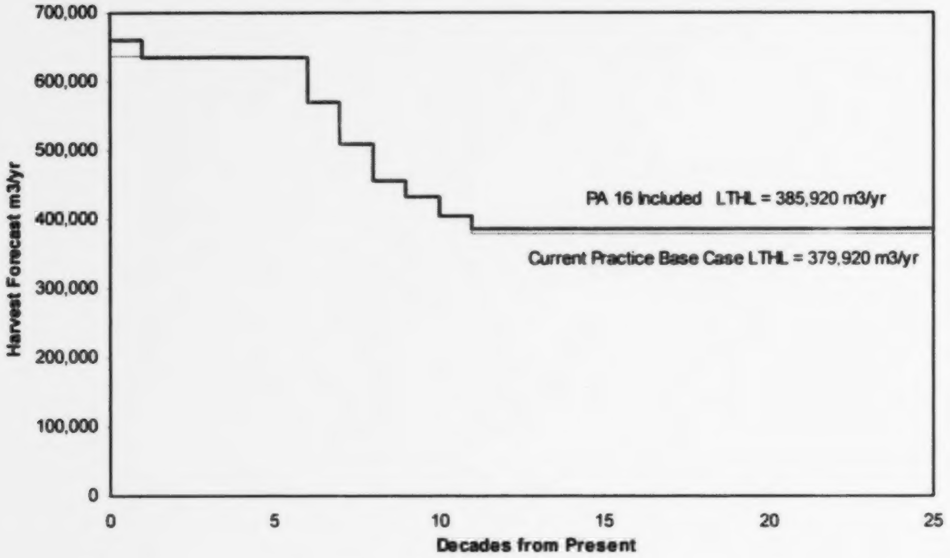

Figure 53. Inclusion of harvest in PA16 stands for 10 years.

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[5] AU definitions for 800 series provided in Appendix B Section 3.1.

Results

Run	Short Term	Mid Term	Long Term
Inclusion of PA16	Initial period is higher by 25,000 m3/yr. No change in the number of periods the current AAC can be sustained.	No Change.	The LTHL is 1.6% higher (385,920 m3/yr)

The harvest of 25,000 m3 per year for the first decade increases the harvest level and also results in 1947 ha added into the long term THLB. This additional area and reduced level of disturbance in the NonTHLB result in a slight (1.6%) increase in the long term harvest level. The majority of PA16 stands are not harvested in the first decade and therefore do not impact the harvest projection at any time. The long term harvest level shown here should be viewed as slightly overestimated because some of the gain is occurring because of the removal of random disturbance in the 29,963 ha of PA16 stands, when it fact only a small portion of them end up in the THLB.

6.6 Disturbance in the NonTHLB

In an effort to recognize that natural disturbances occur in the NonTHLB, approximately 948 ha are randomly disturbed (set to age 0) each year in the base case scenarios. To understand the implications of this assumption, the analysis presented in this section removes the disturbance and reports on the associated harvest flow.

How was it Analyzed?

Run	How was it Analyzed?
No Disturbance in the NonTHLB	The random disturbance implemented in each period in the Non THLB was turned off.

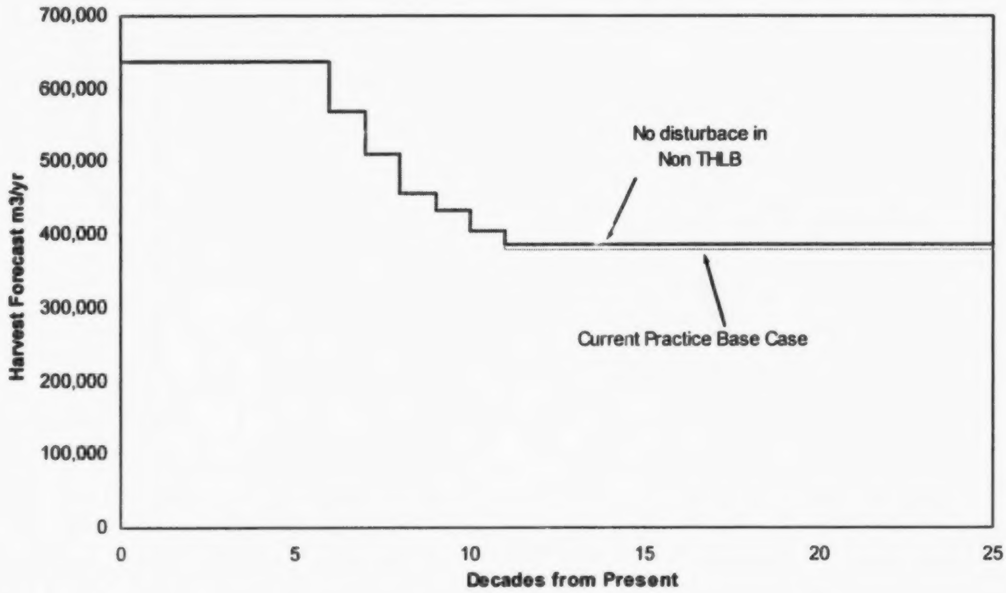

Figure 54. No disturbance implemented in the NonTHLB

Results

Run	Short Term	Mid Term	Long Term
No Disturbance in the NonTHLB	No change	No Change.	The LTHL is 1.8% higher (386,920 m3/yr)

The removal of the disturbance in the NonTHLB eliminated the occurrence of younger age classes in the NonTHLB and resulted in this entire portion of the land base becoming old by the end of the planning horizon. This long term elimination of younger stands in the NonTHLB allowed more harvesting to occur in the THLB because constraints were no longer impacted. The small size of the increase indicates that, in the long term, only limited amounts of NonTHLB contribute to meeting seral objectives because of the spatial arrangement of constraints, or constraints in these areas were simply not limiting harvest.

6.7 Seral Constraints for Landscape Biodiversity

The retention of old seral forest is required in each Landscape Unit (LU) and biogeoclimatic (BEC) variant combination with crown forested area within it. For the Lillooet TSA, spatially explicit Old Growth Management Areas (OGMAs) have been delineated to address this requirement. These OGMA areas are not eligible for harvest and have been implemented in both the current practice and LRMP base case scenarios. The analysis presented in this section explores the implications of using percent seral goals applied to each LU-BEC variant instead of the spatial OGMAs. For example, within the French Bar - ESSFxv 2, 9% of the CFLB is to be in stands older than 250 yrs at all times.

How was it Analyzed?

Run	How was it Analyzed?
Seral Constraints in Place of Spatial OGMAs	Spatial OGMAs were turned off and seral constraints were applied at the landscape unit / BEC variant level. Constraint groups were applied to the CFLB portion of each LU-BEC variant as outlined in the Old Growth Order (and section 7.8.1 of Appendix B). As with the spatial OGMA in the base case, no drawdown was implemented for Low BEO landscape units. A summary of the LU-BEC units is provided in Appendix C.

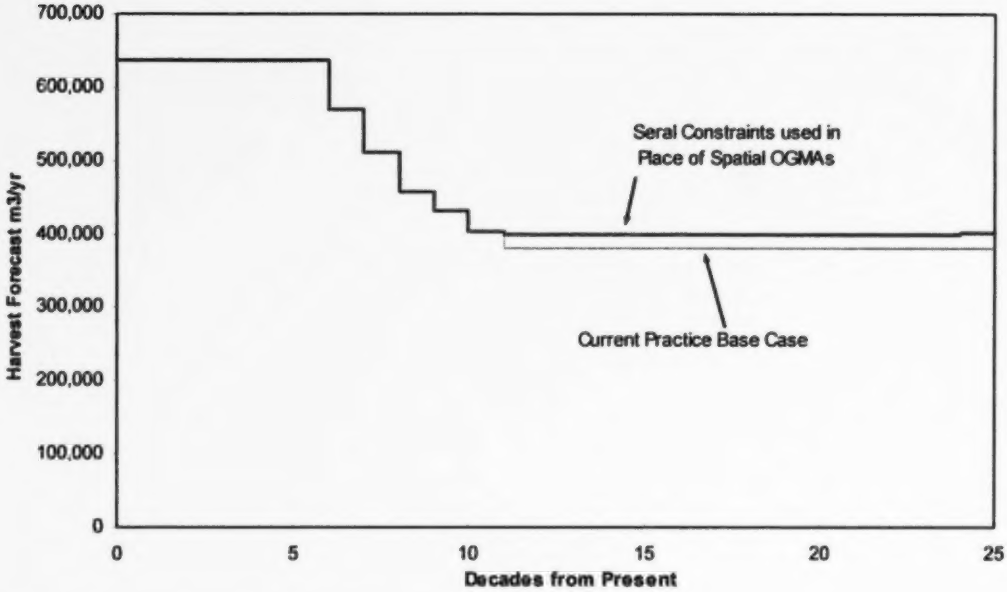

Figure 55. Seral constraints used in place of spatial OGMAs

Results

Run	Short Term	Mid Term	Long Term
Seral Constraints in Place of Spatial OGMAs	No change	No change.	The LTHL is 5.0% higher (398,920 m3/yr)

No change was seen in the short or midterm harvest flow but a 5% increase was seen in the long term harvest level. This increase occurs because seral constraints allow retention to shift to any available Non THLB stands as they become old enough, and the seral constraints only maintain the minimum area required. The spatial OGMAs constrain ~3000 more hectares than required, although much of this may be NonTHLB.

7.0 Summary of Critical Issue and Sensitivity Analyses

Table 9. Summary of Sensitivity Analysis Results

Scenario / Run	% Change in Initial Harvest Level	# of years current AAC is maintained	LTHL	% Change in LTHL
Current Practice Base Case	**635,900**	**60**	**379,920**	**0.0%**
Highest Initial	-	40	379,920	0.0%
Non-Declining	-	0	409,520	7.8%
Oldest First	-	60	368,920	-2.9%
THLB Area (+10%)	-	80	423,920	11.6%
THLB Area (-10%)	-	40	342,920	-9.7%
VDYP Yields (+10%)	-	80	391,920	3.2%
VDYP Yields (-10%)	-	40	365,220	-3.9%
TIPSY Yields (+10%)	-	60	418,920	10.3%
TIPSY Yields (-10%)	-	60	342,920	-9.7%
Greenup ages (+5 yrs)	-	60	371,920	-2.1%
Greenup ages (-5 yrs)	-	60	413,000	8.7%
Minimum Harvest Ages (+10yrs)	-	50	381,920	0.5%
Minimum Harvest Ages (-10yrs)	-	60	376,920	-0.8%
LRMP Base Case	**635,900**	**50**	**364,420**	**0.0%**
Highest Initial	-	40	364,420	0.0%
Non-Declining	-	0	390,800	7.2%
Oldest First	-	50	353,920	-2.9%
THLB Area (+10%)	-	70	402,920	10.6%
THLB Area (-10%)	-	30	328,420	-9.9%
VDYP Yields (+10%)	-	70	369,920	1.5%
VDYP Yields (-10%)	-	30	358,920	-1.5%
TIPSY Yields (+10%)	-	50	396,920	8.9%
TIPSY Yields (-10%)	-	50	327,420	-10.2%
Greenup ages (+5 yrs)	-	50	360,920	-1.0%
Greenup ages (-5 yrs)	-	50	366,920	0.7%
Minimum Harvest Ages (+10yrs)	-	40	364,920	0.1%
Minimum Harvest Ages (-10yrs)	-	50	359,920	-1.2%
Critical Issues Analysis on CP Base Case	**635,900**	**635,900**	**0.0%**	**60**
Exclude Inventory adjustment	-	30	379,920	0.0%
SIBEC SI adjustment	-	60	405,920	6.8%
LRMP MDWR	-	60	375,920	-1.1%
LRMP Moose	-	60	379,920	0.0%
LRMP Mtn Goat	-	60	379,920	0.0%
LRMP Elk	-	60	379,920	0.0%
LRMP Grizzly	-	50	364,920	-3.9%
LRMP Spotted Owl	-	60	382,920	0.8%
LRMP Visuals	-	60	389,920	2.6%
LRMP Parks	-	50	374,920	-1.3%
TERP Low Market Land Base	-22%	0	234,015	-38.4%
TERP Moderate Market Land Base	-5%	0	272,920	-28.2%
Include PA16	+3.9%	60	385,920	1.6%
No Disturbance in the Inoperable	-	60	386,920	1.8%
Seral Constraints in place of Spatial OGMAs	-	60	398,920	5.0%

Only the economic land base and PA16 critical issue analyses impacted the harvest flow in the first decade of the planning horizon.

8.0 Socio-Economic Assessment

8.1 Introduction

To help inform the TSR3 process, this socio-economic assessment (SEA) estimates the likely economic activity associated with alternative timber supply scenarios. A region's timber supply is a fundamental determinant of the size of its forest industry, which is often a leading sector in BC regional economies. The Chief Forester determined allowable annual cut (AAC) effectively sets the upper limit on the annual timber supply available for harvest in a TSA. Changes to an AAC can have important economic consequences so gauging their likely impacts provides important decision making information for TSA stakeholders and the Chief Forester.

This socio-economic analysis compares the level of employment, employment income and government revenues that the current AAC can support with the levels that could be supported by the base case timber supply forecast. It also includes the following elements.

- Brief socio-economic profile of the TSA
- Brief profile of the TSA's forest industry
- Estimate of employment supported by recent harvesting in the TSA

8.2 Current socio-economic setting

8.2.1 Current population and demographic trends

The Lillooet TSA lies in southwestern BC, between the Coast Mountains on the west and the Thompson-Okanagan Plateau to the east. Lillooet is the regional service center accounting for approximately 40% of the TSA's relatively small population of about 6 500. There is one other incorporated village, Lytton, and the unincorporated communities of Bralorne, Gold Bridge and Spences Bridge. A large portion of the TSA's residents are First Nations members, an estimated one-half. They live in the aforementioned communities as well as on reserve communities, such as Xaxli'p and Pavilion. Nlaka'pamux First Nation communities are in the southeast of the TSA near Lytton. Stl'atl'imx First Nation communities are to the east and north centered around Lillooet, and Secwepemc First Nation communities are in the north of the TSA. The BC Government is consulting 33 First Nations about the draft Lillooet LRMP, as they are seen as having a traditional territory interest in the plan area.

The TSA's population growth has lagged the province-wide performance by a wide margin over the past two decades. For the 1981-2001 Census period, the TSA's population dropped by 2.3% whereas BC's population increased by more than 40%. Lillooet, with its College of the Rockies, airport, government offices, shopping malls and other regional services, has registered no growth over the past 20 years, except through a boundary change in the early 1990s. The Village of Lytton's population fell by 30.6% to approximately 330 over the 1981-2001 period. BC Stats forecasts a 0.5% annual population increase for the region's school district over the coming decade but there has been a population decrease in the recent past. Table 10 presents population data for the TSA, Lillooet and the province.

Table 10. Population 1981 - 2001

Areas	2001 Population	% change '01 over '96	% change '01 over '91	% change '01 over '81
Lillooet TSA	6 538	-49.5	4.0	-2.3
Lillooet	2 859[6]	- 4.7	NA[7]	NA
BC	3 096 891	4.9	19.1	42.4

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[6] Lillooet's 2004 population was estimated as 2 814, a 1.6% decrease from its' 2001 level [BC Stats January 13, 2005].

[7] The boundaries of the Village of Lillooet increased between 1991 and 1996. The population in 1996 was 3 001 and in 1991 it was 1 830.

Source: BC Stats

8.2.2 Economic profile

Results from the 2001 Census indicate that employment supported by the public sector comprises the largest portion (38% in 2000) of the TSA's basic sector employment[8]. The forest industry's share of employment dropped in the latter half of the 90s from about 27% in 1995 to 19% in 2000. Table 11 gives the percentage share by basic sector of employment in 2000 and 1995 and the percentage share of employment income by basic sector for 2000.

Table 11. Basic Sector Employment and Employment Income Distribution (% share)

	Forest	Mining	Fish/trap	Agri	Tourism	Hitech	Public sector	Construction	Other basic	Transfers	ONEI[9]	Total[10]
2000 Employment income	20.6	2.1	0.1	6.3	4.7	-	29.3	6.0	4.8	16.6	9.4	100
2000 Employment	19.3	1.6	0.7	11.6	14.8	-	38.0	7.8	6.1	0	0	100
1995 Employment	26.8	0.6	0.8	7.3	15.0	-	37.3	6.1	6.0	0	0	100

Source: BC Stats

Over the past decade, the upper Fraser Canyon region has endured several economic setbacks including reduced traffic and tourism on the TransCanada Highway, the Boston Bar sawmill closure, reduced government services and the closure of BC Rail passenger service. The TSA's dependency on its forest industry decreased from 27% in 1995 to 19% in 2000. The main potential economic boost in the future comes from the Cayoosh Ski Resort, a proposed four-season, 14 000-unit mountain tourism resort development located 55 km southwest of Lillooet in the Melvin Creek area. Its estimated 670 construction jobs and 3 600 operating jobs would be a very large boost to the local economy. The project has gained Environmental Assessment Act approval and the BC Government has granted its proponents approval-in-principle to develop and operate a resort. The resort's proponents are involved in discussions with local First Nations about Land Claims issues and there is no announced construction start date[11].

The TSA's forest sector vulnerability index of 25 (as calculated by BC Stats) is low[12], indicating that its' forest industry, although important, is but one of a few drivers of the regional economy. Its diversity index (as calculated by BC Stats) is 69, amongst the more diversified of any TSA in the province, indicating an economy that is not tied to one or two sectors for its wellbeing[13].

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[8] "Basic sector" is the economics term for the collection of industries that draw revenue from outside the plan area. Non-basic sector is the term for the collection of businesses and organizations that rely on local spending, mainly retail and service businesses Basic industry revenue may arise from the selling of goods (e.g. lumber) or services (e.g. fishing lodge accommodation and guiding). Some industries have basic and non-basic characteristics and judgement is required in allocating between the sectors. The transportation industry is an example, with local long-haul truckers serving local businesses on an outgoing basis and serving outside parties with backhauls. Government services, from a TSA perspective, comprise a basic industry since public services do not directly depend on TSA tax payments and other government charges. The relative employment share shown in Table 11 for each basic sector industry includes the total of its direct, indirect and induced components.

[9] Other Non-Employment Income (ONEI), mainly investment and pension income

[10] Totals do not add up to 100% due to rounding.

[11] Jackie Hamilton & Associates (December 2004) *Major Projects Inventory*. BC Ministry of small Business and Economic Development.

[12] This index is a relative one. Port Hardy is the most forest industry dependent in the province and therefore carries a vulnerability index rating of 100. Victoria is the least vulnerable and so carries an index rating of 0. TSAs and communities are ranked vis a vis the forest sector dependence of these two communities. To indicate the Lillooet TSA's standing, Kamloops TSA has a forest vulnerability index of 12. The Quesnel TSA's forest vulnerability index is much higher at 81.

[13] This index is based on relative dependence on a single sector. If an area was entirely dependent on one sector, its' diversity index would be 0. It would be 100, if the area was equally dependent on each defined sector. The BC diversity index numbers tend to range between 50

The economic importance of the resource extraction industries is more noticeable when the focus is on employment income. The forest industry accounts for about 21% of basic sector employment income whereas the share of its' tourism industry is estimated at 5%, despite tourism having a 15% share of TSA basic sector employment. The relatively lower average incomes of the tourism and public sectors are the reasons for the drop in their economic importance when employment income is the focus.

Jobs with higher incomes can support more spending in local services and retail outlets. The next table presents employment incomes by major BC industries and shows that the forest and coal mining industries have the highest average incomes in the province. The BC logging industry average of $44 642 is 40.0% more than the all industries average of $31 899.

Table 12. Average BC incomes and Lillooet TSA employment multipliers

Industry	Income[14]	Indirect Multiplier	Indirect/ Induced[15] Multiplier
Logging	$44 642	1.16	1.31
Saw milling	$42 555	1.27	1.50
Pulp manufacturing	$58 995	1.68	1.76
Mining	$55 176	1.29	1.54
Government services	$42 258	1.15	1.29
Accommodation services	$20 461	1.08[16]	1.14
All industries average	$31 899	-	-

Source: Statistics Canada and BC Stats

The indirect and induced spending of the resource extraction sectors in the Lillooet TSA is much higher than for other sectors, such as government and tourism. The previous table lists the indirect and combined indirect and induced multipliers for the Lillooet TSA. The TSA's logging industry creates double the indirect and induced employment of its' tourism sector and the local sawmilling creates almost three times the indirect and induced employment in the Lillooet TSA as the tourism sector.

Unemployment rates for the TSA are not available. Kamloops is the most proximate area for which Statistics Canada publishes an unemployment rate. Its annual rates are presented in the following table but they are lower than the rates in the surrounding rural areas. Kamloops' January 2005 rate is about one percentage point higher than the BC average. Since 2002, the Kamloops unemployment rate has declined to a similar level as the provincial average rate, after having been well above the provincial average for several years in the late 90s, 2000 and 2001.

Table 13. Annual Unemployment Rates (%)

Region	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005[17]
Kamloops	12.5	10.9	9.3	10.1	11.6	13.7	8.4	8.7	6.9	7.2
BC	8.7	8.4	8.8	8.3	7.2	7.7	8.5	8.1	7.3	6.3

Source: Statistics Canada and BC Stats

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and 75, so the Lillooet TSA can be characterized as highly diversified within the BC context. The Cranbrook TSA diversity index number of 74 was the highest in the province.

[14] Sourced from 2001 Census, reported in 2000 constant dollars

[15] Assumes no migration in the event of lay-off

[16] The indirect and indirect/induced multipliers refer to the overall tourism sector, which includes the accommodation industry

[17] The 2005 rate is as of January 2005, all other years are annual averages.

8.3 Lillooet TSA Forest Industry

8.3.1 Current Allowable Annual Cut (AAC)

The Chief Forester set the current AAC of 635 900 m3 effective January 2002, which is 7 600 m3 lower than the previous AAC of 643 500 m3 (that became effective in 1996). The current AAC is essentially the same as the 1996 determination except for exclusion of woodlot licences and their apportioned volume. The current apportionment and commitments for the Lillooet TSA are provided in

.

Table 14. Lillooet TSA AAC Apportionment and Commitments (m^3 & % of AAC)

Licensee by Form of Agreement	**m^3**	**% of AAC**
Forest Licences Replaceable	469 456	73.8
Ainsworth Lumber Co. Ltd.	*318 534*	*50.1*
Teal Cedar Products Ltd.	*88 510*	*13.9*
Lytton Lumber Ltd.	*32 778*	*5.1*
Forest Licences Non-Replaceable	25 000	3.9
Peyah Forest Products Ltd.	*15 000*	*2.4*
Marble Canyon Forestry Ltd.	*10 000*	*1.6*
TSL<=10 000 m3, replaceable	5 672	0.6
N'Quatqua Logging Co. Ltd.	*6 987*	*1.1*
BCTS Timber Sale Licence/Licence to Cut	138 366	21.8
Woodlot Licence	2 100	0.3
Forest Service Reserve	3 700	0.6
Total Allowable Annual Cut	635 900	100.0

Source: Ministry of Forests, Revenue Tenures and Engineering Branch

The TSA's apportionment and commitments will likely change in the near future as the Minister of Forests issued orders in December 2004 reducing the volume commitments for the TSA's two Forest Licensees, Ainsworth Lumber Co. Ltd. (Ainsworth) and Teal Cedar Products Ltd. (Teal Cedar), under the "takeback" element of the Forestry Revitalization Program. Under the current AAC apportionment (effective January 2002), replaceable forest licences account for 73.8% of the apportionment of the AAC. Ainsworth has the TSA's largest commitment, 318 534 m^3 attached to its replaceable forest licence (FL), accounting for 50.1% of the AAC. Other licensees are Teal Cedar with rights to 88 510 m3 (13.9%), Lytton Lumber Ltd. with rights to 32 778 m3 (5.1%) and BC Timber Sales (BCTS) with rights to 138 366 m3 (21.8%) of the current AAC.

Since BCTS had more than 20% of the current AAC, no "takeback" process for the auction based pricing component of the purposes was required[18] under the Forestry Revitalization Plan but it was still required to address First Nations and the creation of new small tenures. Teal Cedar holds Replaceable Forest Licences (FL) in the Fraser and Lillooet TSAs and opted to have its "takeback" volume removed from its Lillooet TSA FL, a total of about 40 000 m^3. Ainsworth's FL in the Lillooet TSA will have its commitment reduced by about 34 000 m3. These "takeback" volumes will likely be directed to the region's First Nations.

In July 2004, the BC Government announced the completion of a draft final Lillooet Land and Resource Management Plan (LRMP). Through a government-to-government protocol, the BC Government is currently engaged in consultation and accommodation discussions about the draft final LRMP with the St'at'imc First Nation. As well, the BC Government is in (or plans) consultations about the draft final LRMP with other First Nations that have a traditional territorial interest in the plan area[19]. The LRMP approved by Cabinet may affect the TSA's AAC but any new apportionment and license volume revisions arising from this process are unknown at this juncture.

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[18] The "takeback" is a reallocation of 20 per cent of logging rights from major licensees. Source: BC Ministry of Forests Backgrounder dated March 26, 2003, available at http://www.for.gov.bc.ca/mof/plan/timberreallocation.htm

[19] Approximately 33 First Nations have a traditional territory interest in the Lillooet TSA (Pers. Comm. J. Britton, BC Ministry of Sustainable Resource Development)

Discussions are underway between the region's First Nations about forestry and range agreements through the Forestry Revitalization Plan. Several First Nations with interest in the Lillooet TSA have entered into forest and range agreements in which a timber allocation have been identified.

8.3.2 Lillooet TSA harvest history

The Lillooet TSA's actual harvest has been consistently below its AAC in recent years. The gap between harvest and AAC indicates a weak market demand for the TSA's timber, which arises from the area's relatively higher harvesting cost, despite strong end use market demand in the U.S. The TSA's billed harvest averages 60% of the AAC for the five-year 2000-2004 period and 56% for the three-year 2002-2004 period. Table 15 summarizes the TSA's timber billed harvest volume over the 5-year 2000-2004 period.

Table 15. Lillooet TSA Volume (m^3) Billed by Form of Agreement (2000-2004)

Form of Agreement	2000	2001	2002	2003	2004	3 yr. avg.	5 yr. avg.
Forest licence	323 463	260 181	302 160	214 860	360 459	292 493	292 225
BCTS/SBFEP	156 662	46 126	92 321	16 423	29 403	46 049	68 187
TSL Major	0	0	1 965	0	0	655	393
Road permit	47 199	19 824	20 116	13 748	15 036	16 300	23 185
Other[20]	127	137	978	110	8 153	3 080	1 901
Total	527 451	326 268	417 540	245 141	413 051	358 577	385 890
AAC	643 500	643 500	635 900	635 900	635 900	635 900	638 940
AAC variance Over / (under)[21]	(116 049)	(317 232)	(218 360)	(390 759)	(222 849)	(277 323)	(253 050)
Billed harvest as %age of AAC	82%	51%	66%	39%	65%	56%	60%

Source: BC Ministry of Forests, Revenue Branch

There was an "undercut" of approximately 600 000 m3 over the most recent cut control period (1997-2001)[22], which opens the possibility for the Minister to discuss allocating some or all of the rights to harvest this volume to First Nations.

8.3.3 Lillooet TSA major licensees and processing facilities

Overview

Ainsworth is the TSA's largest forest industry company; the company has rights to approximately one-half of the TSA's AAC and owns a veneer manufacturing plant in Lillooet, the largest of the TSA's two timber processing facilities.

There is a balance between recent TSA timber harvesting volume and current TSA timber processing demand, about 400 000 m3 was harvested in 2004 and the TSA's two timber processing facilities consume this amount on an annual basis now. Bridgeside Forest Industries Ltd. has a value-added mill at Lillooet that purchases 1x4 lumber from primary breakdown mills, such as Abitibi's mill in Mackenzie. Table 16 lists the TSA's wood processing facilities and their locations, main products and estimated annual output capacities.

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[20] Other includes licence to cut.

[21] BC Government cut control policies have allowed licensees to harvest + or – 50% per year from their licenced volume and + or – 10% over a five-year cut control period. These provisions are intended to provide licensees with sufficient flexibility to adapt to changing market and climatic conditions. The minimum harvest requirement was eliminated as of November 2003.

[22] New rules apply to the most cut control time period (2002-2006), so licensees have more flexibility in managing their annual harvest volume making it difficult to predict the amount (if any) of undercut until the end of the cut control period. However, AAC uplifts, in nearby TSAs to address beetle kill damage, likely mean an undercut in the latest cut control period for the Lillooet TSA.

Table 16. Lillooet TSA timber processing facilities

Timber Processing Facility	Location	Main Products	Est'd annual output capacity[23]
Ainsworth Lumber Co. Ltd..	Lillooet	Veneer	132 million sq ft
Lytton Lumber Ltd.	Lytton	Lumber (dimension)	53 million bd ft

Source: Survey of TSA timber processing facilities, BC Ministry of Forests, Economics and Trade Branch (July 2004) *Major Primary Timber Processing Facilities in British Columbia 2003.*

Ainsworth Lumber Co. Ltd.

Vancouver, BC headquartered Ainsworth is the main forest industry employer in the TSA, having harvesting operations and a veneer mill at Lillooet, which feeds a company plywood plant in Savona, 80 km west of Kamloops.

The company is publicly-owned, listed on the Toronto Stock Exchange and focuses on manufacturing wood panel products. It has three oriented strand board (OSB) plants in BC and Alberta Canada and four in the US, in addition to the aforementioned veneer and plywood plants.

The original plant on the site was a sawmill built in 1971. The veneer plant was added in 1980 and the sawmill was closed in 1997. The plant is on First Nations land leased from the Lillooet and Cayoosh First Nations.

The Savona plywood mill produces overlaid forming material for high rise construction, dams and highway infrastructure. It also undertakes custom drying of veneer for other mills. About 90% of Lillooet veneer production is directed to the Savona mill and 10% is sold on the open market. The Lillooet plant's byproduct chips are sold to Canfor.

Ainsworth generated an average of 198 PYs of forest industry employment involved with harvesting and processing[24] its Lillooet TSA Forest Licence timber in 1999. There were approximately 100 PYs in the Lillooet veneer making operation in 1999 and there are an estimated 130 PYs as of March 2005. The current workforce in the plant is estimated as 60% First Nations.

The company's Lillooet veneer manufacturing plant consumes approximately 300 000 m^3 of timber per year at current production rates, three shifts from Monday to Wednesday plus a weekend shift. The volume attached to the company's replaceable forest licence is 318 534 m^3.

Ainsworth owns Pulpwood Agreement #16 having a volume of 330 000 m^3, of which 25 000 m^3 is assigned to the Lillooet TSA. This volume is not included in the TSA's AAC. No harvesting under this tenure has occurred in the TSA.

Ainsworth is in a joint venture with the Pavilion First Nation in Marble Canyon Forestry Ltd., which holds a non-replaceable forest licence. It is also in a joint venture with the Bridge River First Nation in Bridge River Logging Ltd, which owns logging equipment and harvests some of the company's AAC commitment. With several First Nations, the company is discussing operating agreements in traditional territories.

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[23] Based on 480 8-hour shifts per year

[24] Including harvesting, planning, administration, log hauling, road building, silviculture, and veneer manufacturing operations

Table 17. Ainsworth annual average TSA Forest Licence harvests (2002-2004) and employment (1999)

	Result
Harvest (2002-2004)	**Timber volume (m^3)**
Allowable Annual Cut (AAC)	318 534
Annual average billable harvest, 2002-2004	209 372
2004 billable harvest	226 343
Employment (1999)[25]	**Person-Years (PYs)**
Harvesting, silviculture & administration	101
Timber processing	97
Total	198

Source: Ministry of Forests

Lytton Lumber Ltd.

Lytton, BC headquartered Lytton Lumber Ltd. is the second leading forest industry employer in the TSA. The Lytton-based McArthur family owns the mill, which was built in 1980. Including harvesting, planning, administration, log hauling, road building, silviculture, and sawmilling operations, Lytton generated an average of 79.3 PYs of forest industry employment involved with harvesting and processing its Lillooet TSA timber over the 2002-2004 period.

The company's only manufacturing facility is its dimension lumber mill in Lytton, which consumed an annual average of 112 000 m^3 of timber over the 2002-04 period. Its 2x4, 2x6 and 2x10 lumber is directed mainly to BC markets. The company ships residual chips to Weyerhaueser's Kamloops pulp mill. An approximate $1 million capital improvement program is underway. The sawmill uses a double cut band saw and a chip and saw. There is a planer mill, kiln and remanufacturing plant.

The mill's annual timber consumption was approximately 112 000 m^3 over the past three years. Lytton's replaceable forest licence volume is 32 778 m^3, leading the company to acquire approximately 90 000 m^3 from a combination of sources, including other Lillooet TSA licensees, BCTS timber purchases, the Vancouver Log market, Merritt TSA west of Merritt and from the 100 Mile TSA south of 70 Mile. The majority of the company's Lillooet FL timber is processed at its Lytton's sawmill but about 20% is directed to Ainsworth's Lillooet veneer plant.

The company's sawmill averaged 65 PYs of annual processing employment over the 2002-2004 period. Amongst the majority of workers who reside in the TSA, there is a small group who maintain a home outside the TSA, such as in Kamloops and Chilliwack.

An estimated 60% of its mill employment are First Nations persons. The company is in a joint venture with the Siska and Cooks Ferry First Nations in Peyah Forest Products Ltd., the holder of a 10-year non-replaceable forest licence.

The following table presents recent harvesting and employment results for Lytton Lumber in the Lillooet TSA.

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[25] Ainsworth was not able to make its 2002-2004 employment available to the authors of this socio-economic analysis. The 1999 average annual employment for Ainsworth is presented instead. 1999 Ainsworth employment is based on the company's 1999 harvest of 240 787 m^3, which is 15% higher than its 2002-2004 average harvest.

Table 18. Lytton Lumber annual average TSA Forest Licence harvests and employment, 2002-2004

	Result
Harvest	**Timber volume (m^3)**
Allowable Annual Cut (AAC)	32 778
Annual average billable harvest, 2002-2004	37 493
2004 billable harvest	35 371
Employment	**Person-Years (PYs)**
Harvesting, planning & administration	9.9
Log transport	2.0
Road construction & maintenance	0.2
Silviculture	2.2
Timber processing	65.0
Total	79.3

Source: Ministry of Forests, survey of licensees and author's calculations

Teal Cedar Products Ltd.

Teal Cedar Products Ltd., a subsidiary of Surrey, BC headquartered J.S. Jones, harvests timber in the Lillooet TSA but undertakes no processing in the TSA. Teal Cedar generated an average of 12.7 PYs of forest industry employment[26] from its Lillooet TSA Forest Licence timber over the 2002-2004 period.

The company sells its logs to several regional buyers, Ainsworth's veneer plant in Lillooet takes the largest portion, but its logs also are trucked to Lytton Lumber's sawmill, West Fraser Chasm sawmill, Tolko's sawmill in Merritt, Tolko's plywood plant at Hefley Creek and the Cache Creek chip plant. Teal's average harvest over the 2002-2004 period was approximately 16 000 m^3, well below its AAC apportionment of 88 510 m^3.

J.S. Jones closed its Boston Bar sawmill in mid 2002, which was the destination for its Lillooet TSA timber and located close to its southern boundary[27]. The company opted to have its takeback volume removed from its Lillooet TSA commitment rather than its Fraser TSA commitment, which helps feed the company's new mill in Surrey.

The company has a letter of agreement with the Cook's Ferry Band about the company's harvesting in the Marine Creek drainage.

The following table presents recent harvesting and employment results for Teal Cedar Products in the Lillooet TSA.

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[26] Including harvesting, planning, administration, log hauling, road building, and silviculture operations.

[27] The company continues to operate a planer mill at Boston Bar, which processes custom orders for area sawmills.

Table 19. Teal Cedar Products annual average TSA Forest Licence harvests and employment, 2002-2004

	Result
Harvest	**Timber volume (m^3)**
Allowable Annual Cut (AAC)	88 510
Annual average billable harvest, 2002-2004	16 223
2004 billable harvest	21 769
Employment	**Person-Years (PYs)**
Harvesting, planning & administration	8.8
Log transport	1.0
Road construction & maintenance	0.6
Silviculture	2.0
Other	0.3
Timber processing	-
Total	12.7

Source: Ministry of Forests, survey of licensees and author's calculations

BC Timber Sales (BCTS)

BCTS has about 22% of the TSA's AAC, 138 366 m^3. The BCTS harvest in the TSA averaged about 46 000 m^3 over the past three-year period. In 2000, the SBFEP harvest was approximately 160 000 m^3 but quickly dropped off in 2001, reaching a low of about 16 000 m^3 in 2003, well below the BCTS/SBFEP apportionment of 138 366 m^3. There are several reasons for the low BCTS/SBFEP harvest relative to its apportionment: difficult operating area terrain, an extended LRMP process, some approved operating areas converted to parks and a longer planning process due to consultations with First Nations. A more recent issue for the BCTS program has been the grouping of the Lillooet and Merritt TSAs together for the purposes of calculating MPS stumpage. In general, the Merritt TSA is a lower cost harvesting area than the Lillooet TSA, which has a "waterbed" effect in the MPS formula rendering Lillooet TSA BCTS timber less financially attractive.

There was a large recent (March 2005) BCTS sale in the Tommy Creek area of approximately 70 000 m^3, which received a bonus bid of 79 cents over the $25.65 upset price.

The following table presents recent harvesting results for BCTS.

Table 20. BCTS annual average harvests, 2002-2004

	Result
Harvest	**Timber volume (m^3)**
Allowable Annual Cut (AAC)	138 366
Annual average billable harvest, 2002-2004	46 049
2004 billable harvest	29 403

Source: Ministry of Forests

First Nations

First Nations with traditional territory in the TSA do not have ownership interests in TSA wood processing facilities but the majority of the work force at each of the TSA's three wood products plants are First Nations persons. The Ainsworth veneer plant is on leased First Nations land.

Several Lillooet TSA First Nations have forestry interests. The two non-replaceable forest licences involve First Nations; each of Lytoon Lumber and Siska and Cooks Ferry First Nations owns one-third of Peyah Forest Products Ltd. and Ainsworth and Pavilion First Nation own Marble Canyon Forestry. The Cooks Ferry First

Nation has an operating agreement with Teal Cedar and Ainsworth is negotiating operating agreements with several First Nations. N'Quataa Logging Co., owned by the Anderson Lake First Nation, has a longstanding Replaceable TSL. The Siska First Nation has a Forestry and Range Agreement that includes the right to apply for a non-replaceable forest licence and other TSA First Nations are in discussions with the BC Government about their own agreements.

Approximately one-quarter of the province's First Nations have traditional territory claims in the TSA.

Other TSA Wood Processors

Bridgeside Forest Industries Ltd. is the TSA's third largest wood products manufacturer processor and has a Lillooet value added plant. Established in 1986 and formerly known as Bridgestone-Higa, the company was acquired by private Lillooet investors in 2003 from its Japanese owner. The company is currently installing a second fingerjointer to add to its planer and three-kiln operation.

Over the 2002-2004 period, the company averaged employment of 52 PYs and about 65% are First Nations persons.

Its Lillooet value-added plant sources rough 1x4 lumber from BC Interior primary breakdown mills, such as Abitibi's Mackenzie mill and Ardew's Merritt mill, and does not consume timber. It has a Section 16 (value added) SBFEP sale and its contractors harvested approximately 18 000 m^3 from this sale in 2004. The company trades its SBFEP timber for an equivalent volume of rough lumber.

The company's main products and their recent average production volumes are as follows.

Table 21. Bridgeside Products and Production Volumes, 2002-2004

Product	**Volume (MFBM) 2002-04 average**
Prefabricated house framing components (for Japan)	1 169
Industrial & recreational vehicle framing components	4 926
Remanufactured lumber (1x4) sold into the open market from purchased 1x4 the company can't use	720
Total	6 815

Source: Bridgeside Forest Industries

Bridgestone sells byproduct chips to Howe Sound Pulp and Paper and sawdust to Weyerhaeuser's pulp mill at Kamloops.

8.3.4 Forest sector employment and employment coefficients

The average total direct forest industry employment supported by Lillooet TSA harvested timber over the 2002-2004 period is 240.3 PYs in the TSA and 484.1 PYs province-wide. On a province-wide basis, the TSA's annual harvest supported total[28] employment of approximately 970 PYs in recent years.

Table 22 presents estimates of annual employment supported by the 2002-2004 Lillooet TSA harvest broken down by forest industry activity. Employment is reported as an annual average and as the intensity of employment per '000 m^3 of harvested timber. The latter figure is used to calculate potential employment impacts of alternative timber supply scenarios. The average employment levels and coefficients are reported at TSA and provincial levels[29].

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[28] Total employment is comprised of direct, indirect and induced employment. Direct employment estimates come from a survey of licensees. Indirect and induced employment estimates are calculated with the aid of multipliers developed by BC Stats, which uses its input/output model and 2001 census results to estimate local and provincial multipliers. For more explanation about the estimates see the Appendix entitled. *Socio-Economic Analysis Background Information.*

Table 22. Lillooet TSA timber employment estimate (2002-2004)

Activity	TSA		Province	
	Employment (PYs)	Employment Coefficient[30] (PYs/'000 m^3)	Employment (PYs)	Employment Coefficient (PYs/'000 m^3)
Direct employment				
Harvesting[31]	139.9	0.39	157.8	0.44
Timber processing[32]	100.4	0.28	326.3	0.91
Total direct employment	240.3	0.67	484.1	1.35
Indirect/induced employment	118.3	0.33[33]	487.7	1.36[34]
Total employment	358.6	1.00	971.8	2.71

Source: survey of licensee's and author's calculations

The residency of harvesting employment varies by licensee. For example, an estimated 80% of Lytton Lumber harvesting employment resides within TSA boundaries whereas about 40% of Teal Cedar harvesting employment resides in the TSA. The majority of silviculture employment, an estimated 80%, resides outside of the TSA because silviculture workers belong to mobile planting crews. All Lillooet wood processing employment is thought to reside within TSA boundaries because the town is a significant distance from larger centers, such as Kamloops or Chilliwack. A minority of Lytton timber processing employment commutes from outside the TSA.

The majority of the TSA's harvesting occurs from May through February, stopping in the spring because of poor ground conditions. Because of the TSA's steep terrain, possibly one-half of the harvest is logged using cable systems. The other half of the harvest is largely logged with either rubber tired or cat tracked ground skidder systems.

Lillooet TSA licensees are responsible for basic silviculture (i.e. establishment of a free-growing stand) on areas harvested under major licences. BC Ministry of Forests is responsible for silviculture on areas harvested by BCTS award holders and on backlog not satisfactorily restocked (NSR) areas. If an area is harvested in the early summer, planning and site preparation work will often occur in the fall and planting in the following spring.

The forest sector employment estimates do not include BC Ministry of Forests (MOF) employment in the TSA[35]. Lillooet TSA, along with Merritt TSA, is part of the Cascades Forest District. The Cascades District Office is located in Merritt but there is a Field Office in Lillooet, which has 4 FTEs as of December 2004[36]. The District Office in Merritt is staffed with 37 FTEs.

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[29] TSA level is defined as residents of the Lillooet TSA who are employed in the forest industry and its indirect and induced sectors. Provincial level is defined as all forest sector employment in the BC that relies on the Lillooet TSA harvest, including both residents of the TSA and those who live elsewhere in the province.

[30] The direct employment coefficients are calculated from 1999 employment and harvest data. Ainsworth was unable to supply recent employment for its operations so the direct employment coefficients that were calculated for TSR2 were used in this table. These direct employment coefficients are valid for the 2002-2004 period because neither logging methods nor licensees changed in the TSA over the 1999-2004 period. The indirect employment coefficients were supplied by BC Stats and are based on 2001 Census employment data.

[31] Includes harvesting, log salvage, log scaling and harvest planning and administration, silviculture site preparation, planting, spacing, fertilization, pruning and silviculture planning. Log transportation and road building and maintenance are included in the indirect employment estimates.

[32] Includes management, administration as well as facility operations

[33] The blended indirect and induced multiplier is 0.39 but it was reduced by a factor of 0.15 to avoid double counting logging industry employment as both a direct activity and as an indirect/induced activity of the wood processing sector.

[34] The blended indirect and induced multiplier is 1.57 but it was reduced by a factor of 0.15 to avoid double counting logging industry employment as both a direct activity and as an indirect/induced activity of the wood processing sector.

[35] Ministry of Forests employment is not included as part of direct forest industry employment because it is related to administration and statutory requirements and not to timber harvest levels and would not be affected by marginal timber supply changes. MOF employees are accounted for in the public service sector employment estimates reported in Section 8.2

8.3.5 Forest sector employment income

On a province-wide basis, in recent years, the Lillooet TSA harvest supported an estimated average annual total employment income of $36.5 million; $20.9 million of direct forest industry employment income and $15.6 million of indirect and induced employment income. The employment income contribution of the forest industry is high in part because of the industry's relatively higher income levels (listed in Section 8.2.2). Results in Table 23 suggests that there is about $60 000 of forest industry direct employment income for every 1 000 m^3 harvested in the TSA.

Table 23. Lillooet TSA timber supported employment income estimates and coefficients (2002-2004)

Activity	**Employment (PYs)**	**Annual income per worker ($)**	**Total employment income[37] ($million)**	**Employment income coefficient ($/'000 m^3)**
Direct employment				
Harvesting	157.8	44 642	7.04	19 632
Timber processing	326.3	42 555	13.89	38 734
Sub-total direct employment	484.1		20.93	58 366
Indirect/induced employment	487.7	31 899	15.56	43 391
Total employment			36.49	101 756

Source: Statistics Canada and author's calculations

8.3.6 Provincial government revenues

Altogether, the BC Government is estimated to have annually collected revenues of about $10.1 million on average over the 2002-2004 period from the TSA's harvest. There are three main sources of BC Government revenues from the forest sector as follows.

- _Stumpage_[38] – The average 2000-2004 Lillooet TSA stumpage was $5.95/ m^3 and the average 2004 stumpage was $7.82/ m^3. The 2003 average stumpage ($2.03/$m^3$) was particularly low. The stumpage calculation method is in transition at this juncture from the Comparative Value Pricing System (CVP)[39] to a Market Pricing System (MPS). The new MPS went into effect for BC coastal timber on February 29, 2004 but is only used for BCTS timber in the BC Interior. The introduction of MPS stumpage will have a positive impact around the province in lowering industry costs[40].
- _Other forest industry taxes_ – This category includes logging taxes, corporate income taxes, property taxes, export fee in lieu of manufacture against exported logs, gax tax, sales taxes and Workers Compensation Board premiums paid by forest industry employers. The estimate of other forest industry taxes[41] is a unit cost total[42] of $11.42 per harvested m^3. It should be interpreted as a very gross estimate because it includes several tax items that often change on a year-to-year basis.

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[36] In 1999, the Lillooet Forest District Office was listed as having approximately 42 employees [BC Ministry of Forests 2000]. The amalgamation of Merritt and Lillooet Forest District Offices and creation of the Lillooet Field Office occurred in April 2003.

[37] Province-wide basis

[38] Stumpage is a type of royalty paid for the right to harvest and use Crown-owned timber

[39] Adopted in 1987

[40] An estimated $4.50/ m^3 BC average stumpage reduction, current average of $19/ m^3 vs MPS average of $14.50/ m^3.

[41] Unit costs for each tax item were obtained from PriceWaterhouseCoopers (2000) *The Forest Industry in British Columbia* 1999.

- *Provincial income taxes and sales taxes* – Forest industry employees and employees in the industry's indirect and induced sectors pay sales taxes on their personal purchases and provincial income taxes.

Table 24 shows estimates of recent average annual BC Government revenues derived from the Lillooet TSA timber harvest.

Table 24. Average annual BC Government revenues derived from the Lillooet TSA timber harvest, 2002-2004

BC Government revenue source	**Est'd avg. annual revenues ($million)**	**BC Govt. revenue coefficient ($/'000 m^3)**
Stumpage	2.1	5 950
Other forest industry taxes	4.1	11 420
Employment income & employee sales taxes	3.9	10 876
Total revenues	10.1	28 246

8.4 Socio-economic implications of the base case harvest forecast

8.4.1 Introduction

The socio-economic analysis focuses on harvest level changes in the short- to medium-terms (0 – 30 years). Economic impacts are gauged by comparing economic activity that could be supported by the current AAC with activity that could be supported by the base case harvest forecast. Actual harvest levels drive economic impacts, although for the past several years, they have fallen well below the TSA's AAC level. Therefore, employment estimates based on AAC timber volume are expressions of possible future forest industry activity and not the likely activity.

The base case (or Current Practice) timber supply forecast is 635 900 m^3 for the initial six decades, the same as the current AAC level (effective January 2002).

From decades 7 through 11, the projected base case harvest experiences three 10% reductions and three 5% reductions to reach a long term harvest level of 379 920 m^3 in the 11th decade.

The primary differences between the TSR2 forecast and the TSR3 base case forecast is the TSR3 initial annual timber supply is maintained three decades longer and its long term timber supply is slightly higher (by 11 920 m^3). The initial timber supply of the TSR3 base case forecast decreases in the 7th decade whereas the TSR2's initial timber supply was projected to fall in the 4th decade. The TSR2 long term harvest level was 368 000 m^3, achieved in the forecast's 10th decade versus 379 920 m^3 in the 11th decade of the TSR3 forecast.

8.4.2 Short- and Medium-term implications of alternative harvest levels

There are no differences in potential economic activity over the short- and medium-terms between the base case forecast and current AAC because they share the same annual timber supply of 635 900 m^3. The economic constraints in the Lillooet TSA arise from its operating conditions, which raise timber supply cost, and are not due to its timber supply limits.

The base case harvest forecast of 635 900 m^3 (which extends for six decades) could annually support the following.

- estimated 948 PYs of total employment and $39.6 million of employment income in the Lillooet TSA
- estimated 1 600 PYs of total employment and $62.0 million of employment income in the province
- estimated $11.9 million of stumpage and $28.1 million of total BC Government revenues

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[42] Removing Workers Compensation Board premiums reduces the unit tax cost to $6.95 per m^3.

8.4.3 Requirements of BC timber processing facilities

No reduction in the annual timber supply AAC over the next five decades is good news for timber processing facilities that rely on Lillooet TSA wood fibre. The recent shortfalls between available timber supply and actual harvest may be a positive contributing factor in decisions about making capital investments in timber processing facilities.

8.4.4 Lillooet TSA level impacts

The TSR3 base case timber supply of 635 900 m^3 will not result in negative impacts for the regional economy because the current harvest level is well below this figure. There is no job loss in either harvesting or processing if the base case timber supply is implemented. There is potential job gain for the region in the event that the TSA harvest rises above its current levels and approaches the AAC.

8.4.5 Regional timber supply implications

Stability in the Lillooet TSA will contribute to regional timber supply stability. Although there is a balance in recent TSA timber harvests and processing, there is a significant volume of log movement in and out of the TSA because of the peeler log input requirements of Ainsworth's veneer plant and Lytton Lumber's licensed volume is less than one-third of its mill's input requirements. The recent beetle kill AAC uplifts in adjacent TSAs will limit demand on higher cost Lillooet TSA timber.

8.4.6 Summary Comparison Table

Estimated employment, employment income and BC Government revenue impacts based on harvesting the base case harvest forecast appears in Table 25.

Table 25. Estimated socio-economic impacts of implementing the base case harvest forecast

	Base case harvest forecast
Harvesting activity	(m^3)
Timber supply	635 900
Lillooet TSA	
Employment	PYs
Direct	654
Indirect/induced	294
Total	948
Employment income	$ millions
Direct	30.3
Indirect/induced	9.3
Total	39.6
Province[43]	
Employment	PYs
Direct	746
Indirect/induced	854
Total	1 600
Employment income	$ millions
Direct	34.8
Indirect/induced	27.2
Total	62.0
BC Government revenues	$ millions
Stumpage	11.9
Other forest industry taxes	9.6
Employee income and sales taxes	6.6
Total	28.1

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[43] Provincial estimates include Lillooet TSA estimates

8.5 Summary

The TSA's population growth has lagged the province-wide performance by a wide margin over the past two decades. The forest industry's share of TSA employment dropped in the latter half of the 90s from about 27% in 1995 to 19% in 2000. Over the past decade, the upper Fraser Canyon region has endured several economic setbacks including reduced traffic and tourism on the TransCanada Highway, the Boston Bar sawmill closure, the termination of BC Rail passenger service, and reduced government services, such as closing the Lillooet Forest District Office. The main potential economic boost in the future comes from the Cayoosh Ski Resort, a proposed four-season, 14 000-unit mountain tourism resort development located 55 km southwest of Lillooet in the Melvin Creek area.

The Chief Forester set the current AAC of 635 900 m^3 effective January 2002, which is 7 600 m^3 lower than the previous AAC of 643 500 m^3 (that became effective in 1996). The TSA's apportionment and commitments will likely change in the near future as the Minister of Forests issued orders in December 2004 reducing the volume commitments for the TSA's two Forest Licensees, Ainsworth Lumber Co. Ltd. and Teal Cedar Products Ltd., under the "takeback" element of the Forestry Revitalization Program. Under the current AAC apportionment (effective January 2002), replaceable forest licences account for 73.8% of the apportionment of the AAC. Ainsworth has the TSA's largest commitment, 318 534 m^3 attached to its replaceable forest licence (FL), accounting for 50.1% of the AAC.

The Lillooet TSA's actual harvest has been consistently below its AAC in recent years, 60% of the AAC for the five-year 2000-2004 period and 56% for the three-year 2002-2004 period. The gap between harvest and AAC indicates a weak market demand for the TSA's timber, which arises from the area's relatively higher harvesting cost.

There is a balance between recent TSA timber harvesting volume and current TSA timber processing demand, about 400 000 m^3 was harvested in 2004 and the TSA's two timber processing facilities consume this amount on an annual basis now. Bridgeside Forest Industries Ltd. has a value-added mill at Lillooet that purchases 1x4 lumber from primary breakdown mills. More than one-half of the work force at each of the three wood processing plants consists of First Nations persons.

The average total direct forest industry employment supported by Lillooet TSA harvested timber over the 2002-2004 period is 240.3 PYs in the TSA and 484.1 PYs province-wide. On a province-wide basis, the TSA's annual harvest supported total employment of approximately 970 PYs in recent years.

An estimated 33 First Nations have traditional territory interests in the Lillooet TSA, about a quarter of the province's First Nations.

There are no differences in potential economic activity over the short- and medium-terms between the base case forecast and current AAC because they share the same annual timber supply of 635 900 m^3. The economic constraints in the Lillooet TSA arise from its operating conditions, which raise timber supply cost, and are not due to its timber supply limits.

The base case harvest forecast of 635 900 m^3 (which extends for six decades) could annually support the following economic activity.

- estimated 948 PYs of total employment and $39.6 million of employment income in the Lillooet TSA
- estimated 1 600 PYs of total employment and $62.0 million of employment income in the province
- estimated $11.9 million of stumpage and $28.1 million of total BC Government revenues

9.0 Conclusions and Recommendations

This analysis report presents a harvest flow with a stable short-term timber supply under both the current practice and LRMP base case scenarios. The current practice scenario shows the current AAC (635,900 m^3/yr) being maintained for 6 decades before declining 40% to a long-term harvest level of 379,920 m^3/yr. The LRMP scenario shows the current AAC being maintained for 5 decades and then declining 43% to a long-term level of 364,420 m3/yr. The major causes of the reduced harvest projection in the LRMP scenario are the addition of new parks, working land base reductions associated with grizzly bear, and to a lesser degree, cover constraints associated with mule deer winter range.

All harvest projections for the Lillooet TSA indicate a long term harvest level significantly below that of the current harvest level. Existing natural stand volume must be metered out over the next 50-60 years before a steady decline to the long-term level becomes necessary. This pattern is a result of the generally mature forests in the TSA (over 2/3rds of the THLB is at least 100yrs old) containing higher volumes per hectare than what is anticipated from managed stands grown on shorter rotations ages. This current store of volume on the land base will be captured as stands are first harvested. The alternative harvest flow projections (Figure 11 and Figure 27) indicate that dropping to the long term harvest level immediately would provide little benefit in the long term and would not capture this large store of volume on the land base.

The timing of the drop to the long-term harvest level is controlled by timber availability in the 9th and 10th periods. This is the point where managed stands begin to make up a significant proportion of the harvest volume and any change in assumptions that delays availability of these stands or reduces the existing volumes required to get to this point forces an earlier drop in the harvest level. For example, a reduction in existing available volumes (i.e. grizzly habitat reserves) means that the current AAC can only be sustained for 5 decades because volumes must be metreed out more slowly to reach the 9th/10th decades where managed stands begin to contribute.

The forest cover requirements associated with non-timber objectives play a role in shaping both base case harvest flows. Cover requirements interact with age class structure to limit the availability of timber over the planning horizon. Without requirements to limit disturbance and/or maintain older stands on the land base, more timber would be available for harvest in the pinch points. Requirements for VQO's, old seral objectives (OGMAs), and spotted owl LTAC goals are having the largest impacts on the current practice base case harvest forecast, while community watershed constraints appear somewhat constraining and IRM greenup is the least constraining on the harvest forecast. With the addition of the LRMP constraints, the grizzly bear reserve areas have the largest impact, while MDWR objectives are influential but not significant, and elk/moose/mountain goat are not constraining at all at the TSA level.

In order to assess the impacts of potential changes to modeling assumptions, and gain further understanding of the dynamics at work in the base case forecasts, a series of sensitivity analyses were completed.

Uncertainties that altered the harvest level in the short-term (next 20 yrs) were:

- Radical changes in economic assumptions (i.e. assume no occurrence of high market conditions).

Uncertainties that altered the long-term harvest level by at least 3% were:

- Changes to the size of the timber harvesting land base,
- Changes to natural or managed stand yields,
- Reductions in the length of time it takes regenerated stands to green-up,
- Management guidelines for grizzly bear habitat,
- Increase in managed stands site productivity estimates (SIBEC), and
- Allowing old seral retention to shift on the land base over time (non spatial OGMAs).

Although these sensitivities indicate that there is potential for the harvest forecast to change, the current practice base case scenario is felt to best represent the current situation in the Lillooet TSA until final approval is given to the Draft LRMP document. Looking forward, it is highly probable that a number of the sensitivities will soon represent 'current management' and impact timber supply in the mid- and long-term. These include new parks, grizzly bear habitat management, ungulate winter range guidelines, improved estimates of site productivity for managed stands, and improved gains on select seed.

The following factors were not captured or adequately addressed in this analysis and warrant discussion:

1. The provincial Identified Wildlife Management Strategy may reduce harvest levels by up to 1% in the future. Since the establishment of WHA's has been very slow to date, with few being established in the TSA, a 1% reduction has not been included in this base case.
2. A number of new water intakes for domestic purposes have been created in the TSA and were not captured in the dataset. A small increase in netdown area should be recognized around these intakes (<100 ha).
3. The archeological site buffers were generated in 2002 and have not been updated. It is likely that further areas have been identified since that time and could result in a larger netdown area for this factor.

Appendix A – Acronyms

AAC	Allowable Annual Cut
Analysis	Timber Supply Analysis
AU	Analysis Unit
BCTS	BC Timber Sales (Formerly Small Business Forest Enterprise Program)
BEC	Biogeoclimatic Ecosystem Classification
BEO	Biodiversity Emphasis Options
BGB	Biodiversity Guidebook
BL	Balsam Fir
CF	Chief Forester
CFLB	Crown Forested Land base
CORE	Commission on Resources and Environment
CW	Western Red Cedar
DBH	Diameter at breast height (1.3m)
DEO	Designated Environment Official
DFO	Department of Fisheries and Oceans
DM	District Manager
ESA	Environmentally Sensitive Area
FD	Douglas Fir
FES	Forest Ecosystem Specialist
FIP/FC1	Old Forest Cover Digital Files
FMER	Fire Maintained Ecosystem Restoration
FIZ	Forest Inventory Zone
FPC	Forest Practices Code
FRBC	Forest Renewal British Columbia
FSSIM	Forest Service Simulation Model
GIS	Geographic Information System
HLPO	Higher Level Plan Order
HW	Western Hemlock
IWAPS	Interior Watershed Assessment Procedure System
LA	Alpine Larch
LRMP	Local Resource Management Plan
LTHL	Long Term Harvest Level
LU	Landscape Unit
LW	Western Larch
MoF	Ministry of Forests
MSRM	Ministry of Sustainable Resource Management
MSY	Maximum Sustained Yield
MSYT	Managed Stand Yield Tables
MWLAP	Ministry of Water, Land and Air Protection
NCC	Non-Commercial Cover
NDT	Natural Disturbance Type
NP	Non-productive
NRL	Non-Recoverable Losses
NSR	Not Satisfactorily Restocked
NSYT	Natural Stand Yield Tables
OAF	Operational Adjustment Factor
OGMA	Old-Growth Management Areas
PA	Whitebark Pine
PEM	Predictive Ecosystem Mapping
PL	Lodgepole Pine
PSP	Permanent Sample Plot
PSYU	Public Sustained Yield Unit
PW	White Pine
PY	Ponderosa Pine (tree species) or person years (economics)
RIC	Resources Inventory Commission
RM	Regional Manager
RMZ	Riparian Management Zone
ROS	Recreation Opportunity Spectrum
RTEB	Resource Tenures and Engineering Branch
THLB	Timber Harvesting Land base
TIPSY	Table Interpolation Program for Stand Yields (growth and yield model)
TSA	Timber Supply Area
TSR	Timber Supply Review
UREP	Use, Recreation, and Enjoyment of Public
VDYP	Variable Density Yield Predictor (growth and yield model)
VEG Ht	Visually Effective Greenup Height
VQO	Visual Quality Objective

Appendix B – Data Inputs and Modeling Assumptions

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1.0 Introduction

1.1 Purpose of the data package

The purpose of this data package is to:

- provide a detailed account of the land base, growth and yield, and management assumptions related to timber supply that the chief forester must consider under the *Forest Act* when determining an allowable annual cut (AAC) for the Lillooet TSA and how these were applied and modeled in the timber supply analysis;

- provide the evidentiary basis for the information used in the analysis.

This data package does not:

- identify all the information to be considered by the chief forester for his AAC determination. Information brought to the attention of the Ministry of Forest staff from public, First Nations, and government staff that could not be reasonably modeled is brought to the attention of the chief forester separately from this data package.

- replicate the format and land base summary of the data package provided for public review in March 2004 as changes have occurred to reflect new information and timber supply analysis contractor.

1.2 Thematic Data Sources

Many different data layers were compiled to provide input into the timber supply analyses described in this report and they are documented in Table 1. The use of these data layers is described in subsequent sections of this appendix.

Table 1. Data layers

Data Description	Coverage Name	Data Source:	Description	Vintage
Administrative Line Work				
Landscape Units / TSA Boundary	LU	MSRM: K. Eskelin	LU boundaries were used as outer extent of TSA.	Sept 2002
Pulpwood Agreement Boundaries	Pwood	MSRM: K. Eskelin	PA 16 identified.	Oct 2002
Ownership	TSR3_own	Forsite: S. Smyrl	Old FC ownership file updated with 2004 data provided by MSRM from LRDW and ICI sources.	Nov 2004
Proposed Protected Areas (LRMP)	TSR3_own	MSRM: C. Steeves	Data included in ownership cover under LRMP field.	July 2004
Forest Development Plan	fdp	Timberline: D. Myers	Consolidation of all licensees' data.	Jan 2004
Inventories				
Archaeological Site Buffers	Aarch	MSRM: K. Eskelin	Buffers around sites in the provincial heritage database.	Dec 2002
Forest Inventory	Lillooet_fc	MSRM: G. Johansen	Veg rollover files that have had age, ht, and vol adjusted based on VRI phase 2 plot data. Depletions current to 2002.	Nov 2004
Roads	Tflc_rd	Timberline: D. Myers	Includes existing and proposed future roads.	Jan 2003
Biogeoclimatic Ecosystem Classification	Abec_tli	MSRM: D. Lloyd	Recently completed BEC variant mapping with a number of new variants included.	Jun 2004
Predictive Ecosystem Mapping	Pem	Shamaya C. Jones	Based on new BEC mapping, indicates site series	Mar 2004
Slope Classes	Slope40	Timberline: D. Myers	Slope classes of <40 and >=40%.	Dec 2002
Terrain Stability Mapping	terrain	MSRM: C. Steeves	Consolidation of terrain mapping projects. Covers vast majority of the operable area.	Aug 2004
Management Guidance				
Operability Classification	oper	MSRM: K. Eskelin	Indicates area where timber harvesting is not physically/economically possible.	Oct 2002
Economic Operability Zones	Economic	Timberline: D. Myers	Geographic areas used in the process of assigning costs to individual stands.	Nov 2002
Stream, Lake, Wetland Riparian Buffers	Rip_buf	Forsite: S. Smyrl:	Generated from water coverage's with MSRM assigned riparian classes.	Dec 2004
Community Watersheds	Cws	Forsite: S. Smyrl	MSRM coverage updated to include Gun and Twaal Creek watersheds	Nov 2004
Elk Range (LRMP)	Telk_tli	MSRM: C Steeves	LRMP Coverage – elk habitat types	July 2004
Grizzly Bear Watersheds (LRMP)	Lgriz_tli	MSRM: C Steeves	LMRP coverage – grizzly bear identified watersheds.	July 2004
Moose Range And Management Units	Amoose_tli	MSRM: C Steeves	LRMP coverage - Moose habitat types and moose management units.	July 2004
Mountain Goat Escape Terrain (LRMP)	Gt_esc_ter	Timberline: D. Myers	Created using goat winter/kidding areas from the LRMP plus slopes >80%.	Jan 2003
Mule Deer Winter Range (LRMP)	Mdwr	Forsite: S Smyrl	LRMP cover enhanced to contains pseudo planning cells and snow-pack rating.	Nov 2004
Old Growth Management Areas	Ogma	Timberline: D. Coster	OGMAs generated by Timberline using older version of THLB.	Jan 2005
Sheep Wintering Areas (LRMP)	Asheep_tli	MSRM: C Steeves	LRMP Coverage – Bighorn sheep habitat types	July 2004
Spotted Owl Long Term Activity Centers	Aowlac_tli	MSRM: C Steeves	Original source coverage by Nelson Grant	Nov 2004
VQO's (current)	Vqo	MSRM: C Steeves	Identifies DM Policy VQO's and legally established scenic area VQO's	Dec 2003
VQO's (LRMP)	Vqo_lrmp	MoF: Will Robins	Identifies LRMP Zones A and B plus VQO's	Nov 2004

2.0 Timber Harvesting Land Base

2.1 Land Base Definitions

The crown forested land base (CFLB) is the area of productive forest under crown ownership. This is the total area of land base that contributes to landscape level objectives for biodiversity and resource management. The crown forested land base excludes non-crown land, woodlots, non-forest and non-productive areas.

The timber harvesting land base (THLB) is the portion of the management unit where forest licensees under license to the province of BC are expected to harvest timber. The THLB excludes areas that are inoperable or uneconomic for timber harvesting, or are otherwise off-limits to timber harvesting. The THLB is a subset of the crown forested land base.

This analysis was completed using two base cases; one reflecting current management at the time of preparation and one reflecting the implementation of the July 22, 2004 LRMP document. This later base case provides information about the harvest flow if this LRMP document is approved by cabinet. Table 2 summarizes the land base associated with both the Current Management base case and the LRMP base case.

Table 2. Timber harvesting land base area netdown summary – Current Management base case

	Current Practice Base Case			**LRMP Base Case**		
Land Base Element	**Netdown* Area (ha)**	**% Total**	**% CFLB**	**Netdown* Area (ha)**	**% Total**	**% CFLB**
Total area (Lillooet Forest District)	1,124,999	100%		1,124,999	100%	
Less:						
Private Land, First Nation reserves	46,539	4%		46,539	4%	
Woodlots, Misc Leases	9,800	1%		9,800	1%	
Total TSA Area	1,068,659	95%		1,068,659	95%	
Non forest / Non-productive forest	530,792	47%		530,792	47%	
Non-Commercial Brush	531	0%		531	0%	
Unclassified existing roads, trails and landings	9,240	0%		9195	0%	
Total Crown Forested Land Base (CFLB)**	528,097	48%	100%	528,142	48%	100%
Less:						
Parks and Ecological Reserves	60,945	5%	11%	76,963	7%	14%
Inoperable/Inaccessible	96,045	9%	18%	94,414	8%	18%
Unstable / Sensitive Terrain	34,899	3%	6%	33,084	3%	6%
ESA - Avalanche	735	0%	0%	710	0%	0%
Non-Merchantable or Problem Types	31,281	3%	6%	29,111	3%	5%
Low Sites	45,387	4%	8%	42,465	4%	8%
Riparian Management	7,557	1%	1%	7,414	1%	1%
Cultural Heritage	818	0%	0%	818	0%	0%
Community Watershed Intakes	3	0%	0%	3	0%	0%
Timber Harvesting Land Base –THLB (ha)	**250,426**	**22%**	**47%**	**243,160**	**22%**	**46%**
Volume Reductions:						
Future Wildlife Tree Patches (%)	14,525	1%	3%	14,103	1%	3%
Future roads, trails and landings	10,231	1%	2%	9,757	1%	2%
Long Term Timber Harvesting Land Base (ha)	225,670	20%	43%	219,301	19%	42%

* Netdown area represents the area that was actually removed as a result of a given factor. Removals were applied in the order shown above, thus areas removed lower on the list do not contain areas that overlap with factors that occur higher on the list. For example, the unstable terrain netdown did not include any non-forested or inoperable area.

** Crown forest in this context denotes the forest area that contributes to forest management objectives, such as landscape-level biodiversity, wildlife habitat and visual quality. It did not include alpine forest or Non Productive areas with trees species.

2.2 Changes from TSR2 affecting the THLB

Since the last timber supply review for the Lillooet TSA, several input datasets and assumptions have changed and have implications on the size of the timber harvesting land base. In summary, these changes were:

- Existing road losses are now explicitly (spatially) identified and removed from the land base contributing to timber supply;

- Existing forest inventory age and height values were adjusted (*Lillooet Forest District VRI Statistical Adjustment Addendum, April 2003 + July 14/2004 spreadsheet*) and have implications on low site and non merchantable stand netdowns.
- Existing forest inventory has been updated for disturbance to 2002 and projected to Jan 2004;
- Pulpwood agreement stands no longer contribute to the THLB;
- Terrain mapping has been completed on almost all of the operable land base and it was used in place of ESA soils data;
- Ownership data was updated to reflect the creation of more woodlots;
- Spruce Lake Order in Council (OIC) protected area is explicitly identified and removed from the land base contributing to timber supply; and
- Archaeological sites are now explicitly identified and removed from the land base contributing to timber supply.

The final classification indicates a current timber harvesting land base of 250,426 ha (Current) or 243,160 ha (LRMP) which represent 15% and 18% reductions from the TSR2 THLB (295, 802 ha) documented in the Chief Forester's AAC rationale document. The vast majority of this difference stems from the removal of the pulpwood agreement stands from the THLB. The TSR2 Analysis Report (Jan 2001) indicated that the inclusion of the pulpwood agreement area increased the THLB by approximately 42,500 ha, while the pulpwood agreement sensitivity analysis done in this report will add 29,963 ha to the THLB (Table 17).

2.3 Exclusions from the Crown Forested Land Base

2.3.1 Ownership classes not part of the TSA

The area of the Lillooet Timber Supply Area is divided into ownership codes that describe the nature of ownership of a particular parcel of land. For forest management in the Lillooet TSA, only those lands that are under provincial crown ownership will contribute to forest management objectives, like landscape level biodiversity. Ownership classes coded for timber management (coded as '-C') contributed toward timber harvesting activities. Parcels of land coded as non-contributing ('-N') were treated as land base removals.

Table 3 describes the various ownership codes in the Lillooet TSA, and their contribution to the Crown Forested Land Base, the Timber Harvesting Land base, or both. Parks and protected areas are described in more detail in section 2.4.1.

The ownership layer was provided by the Ministry of Sustainable Resource Management in Kamloops, BC in the traditional forest cover format. This file was then checked against current data for private land, reservations, parks, woodlots, and other federal land and updated where necessary.

- Woodlots 0360, 0369, 0366, 1478, and 0365 were added based on Exhibit A maps while other woodlots were added using digital data supplied by the Cascade Forest District.
- The Spruce Lake OIC park was included as an existing park.
- As indicated by the LRMP, 9 new park areas were added: Arthur Seat extn, Bridge Delta, Cerise Cr, Fred Antoine, French Bar, Gwyneth Lake, Marble Canyon extn, Skihist extn, and Yalokom. The Spruce Lake OIC park designation was also refined by the LRMP and called the South Chilchotin Park but there was no effective difference in the area excluded from logging.

Note: No Timber Licences are present in the Lillooet TSA land base.

Table 3. Ownership codes and application in TSR3

Ownership Code	Description	Percent Contribution to CFLB	Percent Contribution to THLB	Current Mgmt Total area (ha)	LRMP Total area (ha)
40N	Private Land	0%	0%	25,059	25,059

52N	First Nation Reserves	0%	0%	21,480	21,480
60-N	Ecological Reserves	100%	0%	75	37
61-C	U.R.E.P Reserves – contributing	100%	100%	3,985	3,751
61-N	U.R.E.P Reserves – non-contributing	100%	0%	771	743
62-C	Forest Management Unit	100%	100%	844,708	822,479
63-N*	Provincial Park Class A	100%	0%	182,943	208,673
69-C	Misc. Reserves – contributing	100%	100%	35781	32,712
69-N	Misc. Reserves – non-contributing	100%	0%	397	264
70-N	Timber Licenses	0%	0%	0	0
77N	Woodlot Licenses	0%	0%	9,743	9,743
99N	Misc Leases	0%	0%	57	57
Total Area				**1,124,999**	**1,124,999**

* More detail is provided on park areas in Table 7.

2.3.2 Non-forest, non-productive and non-typed

All land classified as non-forest, non-productive (lakes, swamps, rock, alpine, *etc.*), or non-typed in the forest cover files were excluded from the timber harvesting land base. The non-forest and non-productive areas and codes used in the netdown process are listed in Table 4.

Table 4. Non-forest and non-productive area

Description	**Percent Reduction**	**Total area (hectares)**	**Current Mgmt Netdown Area (ha)**	**LRMP Netdown Area (ha)**
Alpine	100%	323,963	323,888	323,888
Alpine forest	100%	65,386	65,376	65,376
Clearing	100%	4,854	403	403
Clay bank	100%	295	165	165
Gravel bar	100%	53	25	25
Icefield	100%	30,161	30,161	30,161
Lake	100%	16,977	16,854	16,854
Meadow	100%	1,568	1,556	1,556
Non-productive	100%	38,381	35,953	35,953
Non-productive brush	100%	6,651	6,279	6,279
Non-productive burn	100%	4,833	4,325	4,325
No Typing Available	100%	4,402	4,405	4,405
Open range	100%	25,452	16,288	16,288
Rock	100%	18,801	18,163	18,163
River	100%	4,072	3,826	3,826
Sand	100%	14	14	14
Swamp	100%	1,202	1,090	1,090
Urban	100%	4,351	2,021	2,021
Totals		**547,014**	**530,792**	**530,792**

2.3.3 Non-commercial cover

Non-commercial cover is productive forest land that is otherwise occupied by non-commercial tree or shrub species. This area of land does not currently grow commercial tree species, and is not expected to do so without intervention. This area was therefore excluded from the crown forested land base.

Table 5. Non-commercial cover

Description	**Percent Reduction**	**Total Area (ha)**	**Current Mgmt Netdown Area (ha)**	**LRMP Netdown Area (ha)**

Non-Commercial (NF Desc=NCBr or NC)	100%	720	531	531

2.3.4 Roads, trails, and landings

Quantifying the area that is, and will be, disturbed by roads, trails, landings (RTLs) and other access features in the TSA is an important part of determining the THLB. Areas that were expected to remain non-productive were removed from the working land base as outlined below.

2.3.4.1 Existing classified roads

Classified roads are those roads identified in the forest cover inventory. These roads are frequently large roads or highways with a wide right-of-way. This area was removed from the THLB based on coding in the forest cover file. See Table 4 for a review of the codes netted out of the forested land base – roads were typically classified as 'Urban' or 'Non-Productive'.

2.3.4.2 Existing unclassified roads, trails, and landings

Roads not represented in the forest cover data are considered unclassified. These roads and trails are tracked digitally as line features in a separate inventory. For input to modeling, areas associated with these features are estimated and removed from the timber harvesting land base.

To determine the amount of productive forest lost to roads, trails and landings, the former Lillooet Forest District surveyed a number of drainages in 1997 to determine the extent of the impacted areas. This survey identified the width of the non-productive area along roads and trails and the area lost due to landings. The road width averages in the 1997 survey were applied to road line features in a GIS. These road areas are shown in Table 6 and were excluded from the timber harvesting land base by assigning a percent non-productive to each THLB polygon in the model according to the amount of road area that overlapped it. The procedure was completed as a separate exercise after the modeling resultant was completed and the THLB identified. Thus, the area reported for existing roads netdown in Table 2 is the area removed strictly as a result of roads, trails and landings (no overlapping netdowns).

As landings prior to the Forest Practice Code are not required to be rehabilitated, a 2% reduction for landings was applied to all stands harvested prior to 1996. Where appropriate, this 2% was added to the percent non-productive assigned to polygons in the model.

Table 6. Access feature classification

Access feature/ class	Slope %	Effective Road Width (m)	Total Area (ha)	CFLB Area (ha)	Current Mgmt Netdown Area (ha)	LRMP Netdown Area (ha)
Highway	All	16 m	16,598	11,750	9,240	9,195
Regional Paved Roads	All	12 m				
Logging Road	<10%	9.33 m				
Logging Road	10-30%	11.76 m				
Logging Road	>30%	15.27 m				
Trail	<10%	4.49 m				
Trail	10-30%	5.68 m				
Trail	>30%	9.96 m				

Note: Overlap between these features and non-forested areas exist but no double counting occurred during netdowns.

2.3.4.3 Future roads, trails and landings

Deductions for future roads are necessary to account for the unproductive area created as new roads, trails and landings are built. A first logging entry into any unroaded areas in the TSA will capture all of the timber volume available in that stand. Any subsequent entries will harvest less volume, recognizing the unproductive area that would then exist as roads, trails and landings.

TSR2 used a yield reduction of 7.5% to modeled area lost to future roads, trails, and landings (9% - 1.5% for existing roads). For this analysis, the same percentage (7.5%) has been used but applied only to areas of the THLB that were at least 250 m from currently existing roads and stands older than 40 yrs old. The area within 250m can currently be accessed from the existing roads and the 40 yr age is designed to eliminate currently logged blocks from having this netdown applied.

Deductions for future roads, trails and landings were applied as a volume reduction to the yield tables of all future managed stand analysis units (200 series AU's). The THLB area meeting the criteria described above (136,418 ha) was multiplied by 7.5% to get an effective area reduction (10,231 ha). This area was then calculated as percentage of the total area on the future managed stand yield curves (212,375 ha) and implemented as a volume reduction (4.8%) on these curves. This percentage is lower than 7.5% because a portion of the area on 200 series AU's can already be serviced by the existing road infrastructure (ie. within 250 m).

2.4 Exclusions from the Timber Harvesting Land Base

2.4.1 Parks and Protected Areas

Provincial parks and other protected areas in the Lillooet TSA are excluded for the timber harvesting land base but can contribute to non-timber objectives. The exception to this is the Stein Valley Nlaka'pamux Heritage Park, which is considered to be a self contained identity in which all non-timber objectives are met. It is included in the CFLB area but is not allowed to contribute toward non-timber objectives outside the park. Table 7 summarizes the existing and proposed parks and protected areas in the TSA and indicates how the area were treated in each of the base cases.

Table 7. Parks and Ecological Reserves in Lillooet TSA

		Current Mgmt Base Case		**LRMP Base Case**	
Description	**CFLB Contribution**	**Total Area (ha)**	**Netdown / CFLB Area (ha)**	**Total Area (ha)**	**Netdown / CFLB Area (ha)**
Arthur Seat Study Area	100%			2,308	1,581
Bridge Delta	100%			972	652
Cerise Cr	100%			1,376	459
Duffey Lake	100%	2,088	605	2,095	612
Fred Antoine	100%			8,207	7,161
French Bar	100%			1,134	384
Gwyneth Lake	100%			142	114
Marble Canyon	100%	320	138	2,564	1,006
Skihist	100%			433	169
Skwaha Lake	100%	814	539	814	539
Spruce Lake / South Chilcotin	100%	71,272	20,801	71,272	20,801
Stein Valley Nlaka'pamux	100%	108,412	37,909	108,412	37,909
Yalokom	100%			8,945	4,800
Ecological Reserves (60-N)	100%	111	97	37	28
U.R.E.P Reserves (61-N)	100%	771	616	743	603
Misc Reserves (69-N)	100%	397	240	264	146
Totals		**184,150**	**60,945**	**209,717**	**76,963**

The Spruce Lake Protected Area in the Southern Chilcotin mountains is protected under the Environmental Land Use Act (Order in Council 524 Vol. 28 No. 11 dated April 18, 2001). This area overlaps with the South Chilcotin Protected Area proposed in the LRMP.

The current draft LRMP document (July 22, 2004) identifies:

- 8 new protected areas (Bridge Delta, Cerise Cr, Fred Antoine, French Bar, Gwyneth Lake, Marble Canyon Extn, Skihist Extn, Yalokom),
- 1 study area (Arthur Seat), and
- Spruce Lake protected area renamed as South Chilcotin protected area. The LRMP does not change the location or size of this protected area but it does allow for greater mining and recreation opportunities in specific sections of the protected area.[1]

Both the new protected areas and the Arthur Seat study area have received initial protection as Designated Areas under Part 13 of the Forest Act effective June 30, 2004 (B.C. Reg. 3001/2004 http://www.for.gov.bc.ca/tasb/ legsregs/forest/faregs/lillooet/lillooet.htm). This designation allows the Ministry of Forests to halt, limit or place conditions on development in these areas. Arthur Seat was identified as a proposed study area as it was felt further First Nations consultation was required. For the purpose of this analysis, the Arthur Seat area has been treated in the same manner as all other LRMP proposed parks (see Table 7). If this area is not approved with the LRMP, then an upward pressure on timber supply should be recognized.

As shown in Table 7, the current base case will remove the currently existing parks while the LRMP base will remove both the current and proposed parks.

2.4.2 Inoperable or Inaccessible Areas

Inoperable areas are areas that are not available for timber harvesting because of adverse terrain characteristics such as steep slopes, unfeasible road access or uneconomic yarding or flight distance. The MoF, in coordination with licensees, delineated operability lines for the Lillooet TSA in 1995.

This review assessed the forested land base for physical operability. All land classified as 'physically inoperable' was excluded from the timber harvesting land base as shown below.

Table 8. Inoperable areas

Operability Attribute	Total CFLB Area (ha)	Current Mgmt Netdown Area (ha)	LRMP Netdown Area (ha)
Inoperable (I)	116,566	96,045	94,414

A comparison of Forest Development Plans by Ed Nedokus, Stewardship Officer, Cascades Forest District, indicated that current harvesting is generally occurring within the operability lines. The TSR3 dataset indicates the following FDP areas occur in the NonTHLB: Approved blocks – 3132 ha, Proposed blocks - 878 ha, Logged blocks - 3441 ha.

2.4.3 Economic Operability

To understand the implications of economic operability within the Lillooet TSA, the Lillooet TSA Association created maps reflecting economic zones from which harvesting costs could be assigned. This data was digitized by Timberline Inventory Consultants and has been used in sensitivity analyses. These analyses reduced the THLB by (1) excluding stands not viable in low market conditions) and (2) excluding stands not viable in moderate market conditions. Net values were determined for each stand based on value assigned at the AU level and costs assigned using AU's, slope class (<=40 or >40%), and economic zone (access costs).

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[1] Personal Conversation with Jim Britton, MSRM Planner - Kamloops

Table 9. Economic operability areas (sensitivity analysis only)

Market Condition	THLB Area (ha)
High	250,426
Moderate	179,989
Low	148,378

Moderate market conditions were defined using stand values half way between high and low market conditions. These stand values were then compared to the same cost structure used in all of the market conditions to define viable (positive contribution) stands.

2.4.4 ESAs and Unstable Terrain

Environmentally sensitive sites and areas of significant value for other resource uses have been delineated within the forest cover inventory as Environmentally Sensitive Areas (ESA's). ESA's are broad classifications that indicate sensitivity for unstable soils (E1s), forest regeneration problems (E1p), snow avalanche risk (E1a), and high water values (E1h). ESA soils mapping has generally been replaced with level C and level D terrain stability mapping because it provides a better estimate of unstable terrain. The vast majority of the operable land base in the Lillooet TSA has terrain stability mapping and thus only a very small amount of E1s data was used.

Terrain stability mapping was completed by JMRATA Inc. The coverage includes 252,676 ha at a TSIL C level and 244,000 ha at a TSIL D level. Additional area was mapped in the inoperable land base but was not utilized in this analysis because the area was already excluded.

TSIL C - 1:20,000 mapping, full typing, 5 class stability, 25% field checks, completed on operational ground (high priority).

TSIL D - 1:20,000 mapping, full typing, UPS stability, 10% field checks, completed on operational ground (lower priority).

The netdowns for terrain stability are meant to capture those areas where logging would be completely excluded. There is an acknowledgement that the classes assigned in the terrain mapping are further refined in the field during cutting permit development. For example, a portion of the polygons mapped as "unstable" or "partially unstable" are typically confirmed to be acceptable for timber harvesting in the field. These mapped classes serve as a red flag for field operations and do not automatically exclude these areas from harvest. The reductions identified for terrain stability (Table 10) are based on the expert opinion of Tim Giles, MOF SIFR geomorphologist (Tim Giles, pers. comm. 6 July 2004).

Table 10. ESA and unstable terrain netdown areas

ESA Type	Description	Reduction Percent	CFLB Area (ha)	Current Mgmt Netdown Area (ha)	LRMP Netdown Area (ha)
TSIL C class V	High likelihood of landslide initiation following harvesting or road construction	90%	12,992	11,736	11,502
TSIL C class IV	Moderate likelihood of landslide initiation following harvesting or road construction	10%	68,625	6,874	6,677
TSIL D class U	Unstable	90%	6,684	6,033	5,709
TSIL D class P	Potentially Unstable	25%	37,563	9,414	8,354
E1s	Very Sensitive Soils	100%	933	842	842
Totals			**126,797**	**34,823**	**33,084**

E1p and E1h areas were not excluded from the land base because MoF District staff do not believe they result in a reduction to harvestable area once other netdown are considered. This assumption is consistent with TSR2. E1a (avalanche runout) areas were removed from the land base.

The partial netdowns described for terrain stability mapping were implemented spatially as an area reduction with the forested operable land base. The total area of each terrain class in the operable forested land base was calculated and then the smallest polygons were excluded from the THLB until the area target (%) was reached. For example, the area removed for 'class V' was selected by sorting the polygons by size and then selecting polygons, starting with the smallest, until the area selected reached 90% of the total. The percentage area target for netdown (gross area) was set using the operable portion of the land base because this is the area where the percentage statistics are relevant. (i.e. 90% of the class V area below the operability line was not eligible for harvesting).

2.4.5 Non-merchantable or problem forest types

Non-merchantable forest types are stands that contain tree species not currently utilized in the TSA, or timber of low quality, small size and/or low volume. Non-merchantable types are entirely excluded from the timber harvesting land base as shown in Table 11. A summary of forest management opportunities in non-merchantable forest types prepared by L.P. Atherton & Associates[2] agrees that there is likely little opportunity in these unmerchantable types. Type definitions are consistent with those used in TSR2 but their application in this analysis differs. Stands were excluded here even it they contributed to the pulpwood agreement land base.

Table 11. Non-merchantable forest types

Type ID	Stand Criteria	CFLB Area (ha)	Current Mgmt Netdown Area (ha)	LRMP Netdown Area (ha)
1	All deciduous leading stands (ITG>34). without a logging history[3]	3,018	1,933	1,858
2	All coniferous stands, except Fd leading, with a stocking class of 'R'	111	97	97
3	All Fd stands > 100 yrs with ht class 1	1,160	790	737
4	All Fd stands > 80 yrs with ht < 18 m and crown closure class <=2	9,888	6,927	6,593
5	All Bl/Sx/Cw/Hw stands > 100 yrs with ht class 1	630	353	353
6	All Cw/Hw stands > 100 yrs with ht class <=2	0	0	0
7	All Pa stands > 100 yrs with ht < 14 m	1,831	808	704
8	All Pl stands > 80 yrs with ht < 14 m and stocking class = 4	15,071	11,586	10,282
9	All Pl stands > 80 yrs with ht < 14 m and crown closure < 5 and stocking class <> 4	526	278	277
10	All Py stands > 80 yrs with crown closure class < 5	14,630	8509	8210
Total		**46,865**	**31,281**	**29,111**

* Height class 1 is <10.5m, height class 2 is >= 10.5m and < 19.5m

** Stocking class 0 is immature, 1 is >= 76sph over 27.5cm dbh, 2 is <76sph over 27.5 cm dbh, 3&4 describe small diameter, dense pine stands.

Stands within parkland or alpine BEC variants were not specifically excluded from the land base because the BEC variant mapping is coarse relative to the detailed stand level mapping available in forest cover data. Forest stand attributes were used to remove those stands not suitable for harvesting. Non-merchantable stands at higher elevations were excluded as inoperable/non merchantable or were caught using stand specific attributes (low site index, marginal species) or other netdowns (unstable, ESAs, etc).

2.4.6 Low growing potential

Sites with low growing potential are areas that are not expected to contribute to the THLB because they take too long to grow a commercial crop of trees. The site index limits for these areas are based on a review of harvesting practices conducted for TSR1, and are believed to reflect current practice. The criteria for exclusion are listed in Table 12. Their application in this analysis differs from TSR2 in that they these stands were excluded here even it they contributed to the pulpwood agreement land base.

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[2] Forest Management Opportunities in Non-merchantable Forest Types. L.P Atherton & Associates., 2000

[3] Stands with a logging history are not excluded because it is likely only temporary that deciduous is the leading species. Reforestation obligations will require that the stand be coniferous leading once it is free to grow. This is a change from TSR2.

Table 12. Low site netdowns

Leading species	ITG Number	Site Index (SI_{50})	Percent Reduction	CFLB Area (ha)	Current Mgmt Netdown Area (ha)	LRMP Netdown Area (ha)
Douglas-fir	1-8, 32-34	< 8.6	100%	24,925	10,849	10,123
Spruce/balsam/ cedar/hemlock	9-27	< 7.5	100%	22,370	12,037	11,374
Lodgepole pine	28-31	< 9.6	100%	46,635	22,501	20,968
Total				**93,930**	**45,387**	**42,465**

2.4.7 Riparian reserve and management zones

Riparian reserve areas around lakes, wetlands, and streams in the Lillooet TSA are excluded from the timber harvesting land base. Management practices within riparian management zones also resulted in areas excluded from the timber harvesting land base. As per the best management practices described in the *Riparian Management Area Guidebook*, a portion of the volume/area of these zones were retained as shown in the tables below. In the analysis, this was represented by an additional buffer width that was 100% excluded. When the reserve zone and representative portion of the management zone were added together, an "effective" buffer width was defined and then ultimately used in the model. See Table 13 for a description of the netdown assumptions for lakes and wetlands, and Table 14 for a description of stream netdown assumptions.

2.4.7.1 Lakes and Wetlands

Lake and wetland classifications was assigned to all TRIM water polygons by MSRM consistent with the logic in the Riparian Management Guidebook (MoF 1997). Buffers were created adjacent to mapped lakes and wetlands using 'effective' widths as per Table 13 and then removed from the timber harvesting land base.

Table 13. Land base reductions for lakes and wetlands

Lake/Wetland Class	Reserve Zone (RRZ) (m)	Mgmt Zone (RMZ) (m)	RMZ Basal Area Retention (%)	Effective (1) Riparian Zone Width (m)	CFLB Area (ha)	Current Mgmt Netdown Area (ha)	LRMP Netdown Area (ha)
L1 (> 1000 ha)	0	0	0	0	67	23	19
L1	10	0	25	10			
L2	10	20	25	15			
L3	0	30	25	8			
L4	0	30	25	8			
W1	10	40	25	20	783	518	489
W2	10	20	25	15			
W3	0	30	25	8			
W4	0	30	25	8			
W5	10	40	25	20			
Total					850	541	508

(1) Combined riparian zone width = reserve zone + (management zone * (basal area retention / 100))

2.4.7.2 Streams and Rivers

Stream classification ("S Class") was assigned to all TRIM stream reaches by MSRM using a classificaiton algorithm meant to be consistent with the Riparian Management Guidelines Guidebook. Within community watersheds (including Twall and Gunn) riparian classes were limited to S1-S4.

Buffers were applied to mapped streams using 'effective' widths as per Table 14 and then removed from the timber harvesting land base. Effective width calculations are based on best management practices as defined in the Riparian Management Guidebook. The exception to this approach was for S6 streams - MoF District staff indicated that current practice for these streams is to consider the buffers to occur in non-THLB or other reserves so they do not result in any retention in the THLB.

Table 14. Land base reductions for streams

Stream Class	Reserve Zone (RRZ) (m)	Mgmt Zone (RMZ)(m)	RMZ Basal Area Retention (%)	Combined Riparian Zone Width(2) (m)	CFLB Area (ha)	Current Mgmt Netdown Area (ha)	LRMP Netdown Area (ha)
S1(1)	0	100	50	50	11524	7017	6906
S1	50	20	50	60			
S2	30	20	50	40			
S3	20	20	50	30			
S4	0	30	25	8			
S5	0	30	25	8			
S6	0	20	5	0			

(1) Fraser River

(2) Combined riparian zone width = reserve zone + (management zone * (basal area retention / 100)). This distance is applied to both sides of the stream.

2.4.8 Wildlife habitat deductions – Identified Wildlife

The provincial *Identified Wildlife Management Strategy* provides for the creation of wildlife habitat areas (WHA) within the TSA, to protect key habitat features of listed wildlife species. Provincial policy states that WHA's can have a short term AAC impact of up to 1%. At the time of this analysis, no WHA's have been designated in the TSA, however it was recognized that an impact of up to 1% may be considered to account for the eventual deployment and establishment of WHA's.

In this analysis, no reductions were incorporated to address the potential 1% impact for IWMS. The likely impact of IWMS can be addressed by the Chief Forester in his AAC determination.

Table 15. Reductions for Identified Wildlife

Wildlife species	Percent reduction
Identified Wildlife Management Strategy	0%

2.4.9 Cultural heritage resource deductions

A cultural heritage resource is defined in the Forest Act as, "an object, site, or location of a traditional societal practice that is of historical, cultural or archaeological significance to the province, a community, or an aboriginal people". Cultural heritage resources include archaeological sites, structural features, heritage landscape features and traditional use sites.

Archaeological Heritage Resources

The *Heritage Conservation Act* provides for the protection of British Columbia's archaeological sites predating 1846. In accordance with the *Act* (Section 13(2)), archaeological sites may not be damaged, excavated or altered without a permit issued by the Minister or designate.

The Lillooet Timber Supply Area is operationally constrained by the high number of known archaeological sites as well as the unknown number of additional sites across the timber harvesting land base. The majority of the known sites are situated along the river systems. There are three reasons for this: 1) these are areas where historic inhabitants were known to live and conduct activities, 2) these are the areas where archaeological studies have been undertaken, and 3) the upland sites are of a different type that are not as easily recognized. Archaeological sites located further from the river systems are usually found accidentally, often through operational activities. There are many examples of past incidences where harvesting has been delayed, amended or cancelled because of archaeological issues.

The BC Provincial Heritage Register database is the basis for records on archaeological sites. For this timber supply review these sites were excluded from the timber harvesting land base. The size of area removed for the sites was based on GIS buffering (see data source description for Archaeological Site Buffer) using site site type and known site dimensions. This buffering exercise was completed after the previous timber supply analysis but prior to the 2001 AAC determination under the direction of the former Lillooet Forest District Aboriginal Affairs Liaison Officer Majorie Serack.

Archaeological sites have been mapped by MSRM based on archaeological assessments, archaeological sites and culturally modified trees (CMT). As input to the TSR, these features were buffered and removed from the timber harvesting land base. Dependant on the data, and the nature of the archaeological site feature(s), buffer distances of 100, 200 or 500 metres were applied or actual site dimensions rounded up to the nearest 100 metres.

Buffers for sites identified were determined based on site codes as follows:

Table 16. Archaeological Site Codes and Associated Buffers

Site codes	**Buffer diameter**
All except 2, 3, 4, 5, 6	100 m
2, 5	200 m
3, 4, 6	500 m

Site code definitions are as follows:

1. Cultural landscape where there are three or more distinct archaeological features or where the feature is associated with other archaeological sites within 500 metres or where there is reference to the feature in journal records of early settlers or explorers;
2. Cultural depressions (undisturbed) where the number of depressions (house pits) is < 7
3. Cultural depressions (undisturbed) where the number of depressions (housepits) is between 7 and 25
4. Cultural depressions (undisturbed) where the number of depressions (housepits) is > 25
5. Cultural depressions (disturbed by modern or natural events) where the number of depressions is < 7
6. Cultural depressions (disturbed by modern or natural events) where the number of depressions is > 7
7. Burial site (may also be tagged with code #16 where these are from a historic site)
8. Encampment – associated materials with no evidence of permanent dwelling structures
9. Multiple horizons or buried occupational horizons
10. Tool working or material procurement site (quarry)
11. Butcher site
12. Food processing site
13. Trail
14. Petroglyph/Pictograph
15. Petroform
16. Historic use (may be superimposed over prehistoric use sites)
17. Cache pit
18. Roasting pit / Cooking pit
19. Cairn
20. Mat Lodge
21. Lithic Scatter

22. Fishing Station
23. Diagnositic or Formed Tools
24. Spiritual
25. Rare Artifact
26. Bone Fragments
27. Spiritual site (rock caves, traditional information associated with pictographs etc)
28. Culturally Modified Tree Occurrence less than 25 CMT's
29. Hunting Blind or structure
30. Culturally Modified Tree Cluster with greater than 25 CMT's

The netdown area described above amount to a gross area of 1883 ha and an effective netdown of 818 ha in both base cases.

Other Cultural Heritage Resources and Values

Other cultural heritage resources and values may be present within the Lillooet Timber Supply Area. These resources and/or values associated with a land base or forest operation may not have any legal designation. As such they have not been modeled in the base case timber supply analysis. However, such resources and values can be brought forward to the Chief Forester as information to consider in his AAC increase determination. For example the Bonaparte Indian Band have brought forward several studies on traditional cultural use of different drainages for consideration by the chief forester.

Additionally, licensees have identified several First Nations log around areas currently exist in the TSA. These areas have been left in the THLB because they may be temporary and there is no legal designation under which they should be excluded. These log around areas consist of traditional use areas and sacred sites covering 16,672 ha of THLB. The Chief Forester will consider the potential impact of these areas at the time of his determination.

2.4.10 Community watershed intake buffers

A reserve zone upslope of community watershed intakes within community watersheds (including Gun and Twall Creek) was also excluded from the timber harvesting land base. This reserve zone is model as a semi-circle with a radius of 100 m. This results in a gross area of 1.57 hectares for each community watershed intake within the TSA.

There are 21 intakes (~31 ha) currently modeled in the TSR dataset for community watershed intakes. A review of a recent (2004) points of diversion (PODs) coverage revealed that there are 82 active domestic intakes currently identified inside CWS and the Gun and Twaal Creek watersheds. If similar reserves are considered for all intakes this would result in a gross netdown area of ~123 ha.

3.0 Growth and Yield

This section describes the information/data sources, assumptions, and methods for generating growth and yield estimates for both existing and future stands, under both unmanaged and managed conditions.

3.1 Analysis units

To reduce the complexity and volume of information in the timber supply analysis, individual stands were aggregated into 'analysis units' based on dominant tree species (inventory type group), timber growing capability (site index), stand age, and silvicultural management regimes. For example, all pine stands on poor growing sites with a clearcut silviculture regime were grouped into a single analysis unit. Each analysis unit had an associated yield table that provided the net merchantable volume available for harvest at various stand ages.

Analysis Unit definitions are provided in Table 17 for all existing stands (natural and managed). Analysis units in the 500 series represent existing managed stands that were established after recent harvesting. These stands are all less than 28 years of age. All AU's follow a clearcut silviculture regime except drybelt Douglas-fir / ponderosa pine AU's (AU101/102 and 801)

Table 17. Analysis Unit Descriptions: Existing Natural Stands and Associated Future Managed Stands

Analysis Unit Description	**Existing Stand AU #**	**Future Stand AU#**	**THLB Area (ha)**	**SI Inv Wtd Avg**	**Variable used to define analysis unit**				
					Inv type groups	**Site index range**	**Age Range (yrs)**	**Height Range (m)**	**Ecosystem Type***
Existing Natural Stands									
Nat - Fd Drybelt Selection <141	101	1010	17,798	12.2	1-8, 32-34	All	All	All	Dry
Nat - Fd Drybelt Selection 141+	102	1011	11,858	10.9					
Nat - Fd Wetbelt Good/Med <141	103	203	3,819	18.7	1-8, 32-34	≥ 17	≥28	All	Wet
Nat - Fd Wetbelt Good/Med 141+	104	204	889	18.9					
Nat - Fd Wetbelt Poor <141	105	205	34,821	12.5	1-8, 32-34	< 17	≥28	All	Wet
Nat - Fd Wetbelt Poor 141+	106	206	29,233	11.8					
Nat - Sx/Bl/Cw/Hw G/M <141	107	207	6,925	17.7	9-27	≥ 15	≥28	All	All
Nat - Sx/Bl/Cw/Hw G/M 141+	108	208	2,079	16.9					
Nat - Sx/Bl/Cw/Hw Poor <141	109	209	10,899	12.3	9-27	< 15	≥28	All	All
Nat - Sx/Bl/Cw/Hw Poor 141+	110	210	15,562	11.1					
Nat - Pl Good/Med <101	111	211	2,984	17.8	28-31	≥ 16	≥28	All	All
Nat - Pl Good/Med 101+	112	212	6,227	17.9					
Nat - Pl Poor <101	113	213	14,699	12.7	28-31	< 16	≥28	All	All
Nat - Pl Poor 101+	114	214	54,582	12.2					
Existing Managed Stands									
Man - Fd Wetbelt Good/Med	501	601	3,592	17.4	1-8, 32-34	≥ 17	<28	All	Dry
Man - Fd Wetbelt Poor	502	602	1,722	12.5	1-8, 32-34	< 17	<28	All	Wet
Man - Sx/Bl/Cw/Hw Good/Med	503	603	11,054	15.6	9-27	≥ 15	<28	All	All
Man - Sx/Bl/Cw/Hw Poor	504	604	1,813	12.0	9-27	< 15	<28	All	All
Man - Pl Good/Med	505	605	12,774	16.5	28-31	≥ 16	<28	All	All
Man - Pl Poor	506	606	7,097	11.8	28-31	< 16	<28	All	All
TOTAL THLB			250,426	13.1					

Pulpwood Agreement Stands *(used in sensitivity analysis only)***									
PA - Fd Drybelt Selection	801	901	5,975	6.9	1-8, 32-34	All	>80	<17	Dry
PA - Fd Wetbelt	802	902	3,844	7.8	1-8, 32-34	All	>80	<17	Wet
PA - Sx/Bl/Cw/Hw	803	903	1,024	5.4	9-27	All	>80	<17	All
PA - Pl	804	904	18,719	7.3	28-31	All	>80	<17	All
PA – Deciduous	805	905	401	13.0	35+	All	>60	All	All
TOTAL PA Stands			29,963	7.3					

* Dry ecosystems are defined as the IDFxh/xw variants, all PP variants, and all BG variants. Wet ecosystems are all other variants.

** Pulpwood agreement 16 stands are those meeting the description in this table and are not currently in the THLB because of low site or problem forest netdowns. Other types of netdowns (ownership, riparian, terrain, operability) prevented stands from being included in the PA analysis units.

3.2 Site index

Estimates of site productivity were required in this analysis to predict the rate of growth that will occur on each site throughout the TSA. The height of a "site" tree at age 50 (measured at breast height) is one measure of site productivity and is commonly referred to as "site index".

All site index values used in this analysis came from the forest inventory files and were derived using adjusted ages and heights as per the *Lillooet Forest District VRI Statistical Adjustment Addendum, April 2003* report. A sensitivity analysis was completed using site index values correlated to biogeoclimatic ecological classification (SIBEC).

3.2.1 Site curves

For each tree species, site curves were available to illustrate the relationship between stand height and age for a range of site indices. In all cases, this analysis used the standard site curves recommended by the BC Ministry of Forests as identified in the *Site Tools* software. They were as follows:

Table 18. Site index source

Species	Source
Douglas Fir (Fd)	Thrower and Goudie (1992)
Lodgepole Pine (Pl)	Nigh (1999)
Western Red Cedar (Cw)	Kurucz (1985)
Western Hemlock (Hw)	Nigh (1998)
White Spruce (Sw, Se, Sx)	Nigh (1997)
Western Larch	Milner (1992)
Ponderosa Pine	Hann and Scrivani (1987)
White Pine (Pw)	Curtis, Diaz, and Clendenen (1990)
Subalpine Fir (Bl)	Kurucz (1982) (Ba equation)

No species surrogates were necessary in TIPSY as Fd, Pl, and Sx were the only species regenerated in the model.

3.2.2 Forest Inventory Site Index

In the base cases, the attribute adjusted forest inventory age, height and site index values will be used to predict the yields for all natural and managed stands. This site index is generated from the site curves described above using polygon ages and heights (adjusted from VRI ground plots).

3.2.3 SIBEC Productivity Estimates

Site index estimates produced using the MoF SIBEC system will be used to test the growth of managed stands. SIBEC site index estimates were assigned to a stand based on the BEC site series classification. For the sensitivity analysis, the BEC site series information required to use SIBEC was derived from the recently completed PEM project (*Shamaya Consulting - Ecological Services, December 2003*).

A predictive ecosystem mapping (PEM) process was used to inventory ecosystems within the Lillooet TSA. The Lillooet TSA PEM is an important inventory for management of the Lillooet TSA, particularly as the TSA moves forward with Sustainable Forest Management (SFM) planning. To date, an accuracy assessment has not been completed and approved for the PEM. As a result, the Ministry of Forests has not accepted it for use in TSR. However, the ecosystem inventory and the prediction of future stand yields will be tested in a sensitivity analysis.

In instances where no SIBEC values were available for a BEC site series and leading species combination, either cross walk tables developed at the time of the PEM guided the use of a close approximation or inventory site index values were used.

3.3 Utilization level

Utilization levels define the maximum height of stumps that may be left on harvested areas, the minimum top diameter (inside bark), and the minimum diameter at breast height (dbh) of stems that must be removed from harvested areas. These factors were needed to calculate merchantable stand volume for use in the analysis.

Table 19. Utilization levels

Species	Minimum dbh[1] (cm)	Maximum stump height (cm)	Minimum top dib[2] (cm)
Lodgepole Pine	12.5	30	10
All Other Conifers	17.5	30	10
Deciduous[3]	12.5	30	10

[1] Diameter breast height
[2] Diameter inside bark
[3] Deciduous species are not included in the base case but are utilized in the Pulpwood Agreement sensitivity analysis.

Pulpwood agreement 16 has different utilization standards than those documented above. However, as prescribed under TSR 2 they will not be incorporated into the analysis as they result in only a negligible impact on stand volumes within PA 16. The sensitivity analysis that includes the Pulpwood Agreement stands will utilize the utilization standards shown above.

3.4 Decay, waste and breakage for unmanaged stands

Decay, waste and breakage (DWB) factors are applied to natural stand yield tables (VDYP) to obtain net harvest volumes per hectare. Initial net volume estimates were generated using the adjusted inventory attribute values (age, height, site index) in VDYP with the default decay, waste and breakage factors applied. The Lillooet TSA overlaps with the MoF Forest Inventory Zones (FIZ) "C" and "D" and Public Sustained Yield Units (PSYU) 142, 143 and 144.

The initial volume estimates were adjusted using volume adjustment factors from the *Lillooet Forest District VRI Statistical Adjustment Addendum, April 2003* report and July 2004 spreadsheet update. This adjustment was based on a comparison of field samples to inventory projected volumes. Field sample volumes were converted to net volumes through Net Volume Adjustment Factors (NVAF) derived from a sample size of 108 live trees and 7 dead trees. See section 3.10.1 for more information on the adjustment process.

3.5 Operational adjustment factors for managed stands

Operational Adjustment Factors (OAFs) were applied in order to adjust potential yields generated by the TIPSY growth and yield model down to net operational volumes. This included reductions for such things as gaps in stands, decay/waste/breakage, and endemic forest health losses.

There were two types of OAFs used in the TIPSY model. OAF 1 is a constant percentage reduction to account for openings in stands, distribution of stems or clumpiness, endemic pests and diseases, and other risks to potential yield. OAF 2 is an increasing percentage reduction that can be applied to account for decay, waste and breakage. OAF 2 is applied after OAF 1 and increases over time from 0 percent at age 0 through the specified percentage at 100 years of age.

Standard operational adjustment factors (OAF) were used to model managed stands. OAF1 was set to 0.85 (15% reduction) and OAF2 was set to 0.95 (5% reduction).

The OAF's described above were used to define net stand volumes for each of the managed stand analysis curves. These values were used to define minimum harvest ages through identification of ages associated with 90% of maximum mean annual increment. Additional volume reductions were also applied to these 'stand' volumes to address future roads/trails/landings, and future WTP's. These final curves can be found in Appendix D and were used during modeling as 'effective' yields.

3.6 Deciduous Exclusion

Deciduous species are not currently utilized in the Lillooet TSA. However, there is an expectation that deciduous species would be used if harvesting was to occur with respect to PA 16. In the base cases, PA 16 is excluded so deciduous stands do not contribute to timber supply.

Stands where the leading species is deciduous were excluded under "Unmerchantable Forest Types" unless they had a logging history (see Section 2.4.5 for details).

In mixed species stands the deciduous component of the stand is not harvested. Thus, any deciduous volumes in coniferous leading stands were ignored during the compilation of yield curves.

Deciduous stems in future managed stands were treated as 'holes' in the stand and are addressed by the application of the OAF1 reduction.

3.7 In-Block Volume Retention

Retention of merchantable volume in the form of patches and individual trees is a common practice within cutblocks in the Lillooet TSA. Volume is retained to meet wildlife tree requirements and for a variety of other forest management considerations (visuals, UWR, seedtrees, beetle proofing, etc). The amount and location of this retention can directly affect timber supply. Where volume is left in the THLB, and there is no expectation to remove it before the start of the next rotation, it must be accounted for in the timber supply model as a yield reduction.

The practice of leaving wildlife tree patches (WTPs) will be modeled by reducing the average volume per hectare that is harvested, to account for trees that must be left in cutblocks. To allow for the retention of these patches, a **volume reduction of 5.8%** is applied to all yield tables (5.3% for patches and 0.5% for single tree). This percentage is consistent with assumptions used in TSR2 and was based on a review of silviculture prescriptions and forest development plans.

3.8 Natural Stand Volume Projections

Yield tables were derived for existing natural stands using VDYP Batch v6.6d. A yield table was generated for each polygon and then aggregated into one table for each Analysis Unit (AU) using area weighted averages.

As discussed in earlier, all yield estimates were reduced by a further 5.8% to reflect the anticipated impact of wildlife tree patches (Section 3.8). These 'effective' yield tables were used during modeling and are provided in Appendix D.

The average inputs to VDYP are presented in Table 20 but do not represent the actual inputs used, as it was the yield curves that were averaged, not the inputs.

Table 20. VDYP analysis unit attributes

AU #	AU Description	THLB (ha)	Average $SI_{50}^{(1)}$	Average $CC^{(2)}$	Species Composition*							
					S1	P1	S2	P2	S3	P3	S4	P4
101	Nat - Fd Drybelt Selection <141	17,798	12.2	43	FD	88%	PY	8%	PL	2%	S	1%
102	Nat - Fd Drybelt Selection 141+	11,858	10.9	44	FD	93%	PY	5%	PL	1%	S	1%
103	Nat - Fd Wetbelt Good/Med <141	3,819	18.7	49	FD	79%	PL	9%	S	5%	PY	3%
104	Nat - Fd Wetbelt Good/Med 141+	889	18.9	56	FD	79%	PL	12%	S	6%	EP	1%
105	Nat - Fd Wetbelt Poor <141	34,821	12.5	50	FD	82%	PL	13%	S	3%	PY	1%
106	Nat - Fd Wetbelt Poor 141+	29,233	11.8	49	FD	86%	PL	9%	S	3%	PY	1%
107	Nat - Sx/Bl/Cw/Hw G/M <141	6,925	17.7	53	SX	48%	BL	34%	PL	11%	FD	5%
108	Nat - Sx/Bl/Cw/Hw G/M 141+	2,079	16.9	57	SX	59%	BL	29%	PL	6%	FD	4%
109	Nat - Sx/Bl/Cw/Hw Poor <141	10,899	12.3	53	BL	44%	SX	37%	PL	13%	PA	3%
110	Nat - Sx/Bl/Cw/Hw Poor 141+	15,562	11.1	53	BL	50%	SX	38%	PL	5%	HW	2%
111	Nat - Pl Good/Med <101	2,984	17.8	69	PL	91%	FD	5%	SX	3%	BL	1%
112	Nat - Pl Good/Med 101+	6,227	17.9	63	PL	79%	FD	10%	SX	7%	BL	4%
113	Nat - Pl Poor <101	14,699	12.7	64	PL	91%	FD	6%	SX	2%	BL	1%
114	Nat - Pl Poor 101+	54,582	12.2	62	PL	83%	FD	6%	SX	6%	BL	3%

* Data shown for first 4 species only.

3.9 Managed Stand Yield Tables

All future managed stand AU's had an associated existing stand AU from which it inherited stands when they were logged. These future managed stand AU's used the area weighted site indexes from the appropriate existing stand AU's and the regeneration assumption outlined in this document (Section 4.0). These values were input into Batch TIPSY 3.2b to generate a yield curve for each AU.

Existing managed stand yields were derived using the average site index for the unit (Table 17) and the regeneration assumptions outlined in Section 4.0. Existing managed stands are those that currently under 28 years of age.

The regeneration assumptions required to model managed stands in TIPSY consist of:

- Species composition (See Section 4.1);
- Initial density (See Section 4.1);
- Regeneration method (See Section 4.1);
- Area-weighted average site index (See Section 4.1);
- Area-weighted genetic gains (See Section 4.4);
- Operational adjustment factors (See Section 3.5); and
- Regeneration delay (See Section 4.2).

Once net stand yields were obtained from TIPSY, yield estimates were further reduced to reflect the anticipated impact of wildlife tree patches (5.8% - see Section 3.7) and future roads (4.8% - see Section 2.3.4.3). These 'effective' yield tables were used during modelling and are provided in Appendix D.

3.10 Forest Cover Inventory

The forest cover inventory for the Lillooet TSA was completed in four separate re-inventory projects between 1988 and 1990. The present forest cover inventory is updated to Nov 2002 to account for changes in denudation through harvesting. All forest cover inventory information has been converted from North American Datum (NAD) 27 to NAD 83 base and the majority of the data currently exists in VEG / FIP rollover status. The new harvesting recently integrated in the files were either in the INCOSADA format (i.e. data existed) or in the VRI format (i.e. no data existed). 'Results' data linking on opening number was obtained from Tim Salkeld (MoF Victoria) to fill in attribute information for those polygons with no data

The current forest cover inventory was projected to January 1 2004 by MSRM during the VRI adjustment process. The spatial forest cover inventory data was provided as INCOSADA microstation files (mapsheet tiles)[4]. These were then converted to a seamless GIS coverage for use in the analysis. The INCOSADA files were used because these files had recently been updated and had not yet been loaded into the Land and Resource Data Warehouse (LRDW). Attribute data was provided in MS Access databases and had already had the VRI adjustment completed by MSRM as described in the following section.

3.10.1 Forest Cover Inventory Adjustment

The phase 2 vegetation resource inventory (VRI) statistical attribute adjustment study for the Lillooet TSA was completed by MSRM in April 2003 (*Lillooet Forest District VRI Statistical Adjustment Addendum, April 2003*) and updated in July 2004 for rectify a stocking class issue (Lillooet - July 2004 - stk fix.xls). The attribute adjustment is the process of correcting aerial photo-based inventory data using ground sample observations. The purpose of the adjustments is to obtain unbiased overall averages and totals for the TSA by major species groups and to adjust the existing estimation data to obtain individual stand values (*Vegetation Resources Inventory, Attribute Adjustment Procedures, Draft Version 4.4, April 2002*).

For the purposes of TSR 3, the *Fraser Protocol* (MSRM, 2001) was employed to adjust the inventory attributes. The steps in the adjustment process were as follows:

1. Stratify the land base.
2. Perform analysis on VRI ground sample inventory data and develop inventory file adjustment factors for age, height, and volume;
3. Using the factors derived in step one, adjust height and age in the inventory database files;
4. Based on the adjusted inventory file height and age, use Variable Density Yield Predictor (VDYP Version 6.6d) to compute an "attribute-adjusted" inventory volume; and
5. Using the volume adjustment factors derived in step one, adjust the "attribute-adjusted" inventory volume derived in step three. The adjusted volumes are based on net factoring with the net volume adjustment factor (NVAF) applied. This volume is referred to as the final adjusted inventory volume.
6. An Impact Ratio is then calculated to reflect the total change from original volume to final adjusted volume. This ratio reflects the overall change resulting from age, height and volume adjustments.

The impact ratio by species grouping varies from 0.786 for wet belt fir over 140 year to 1.428 for the combined spruce, balsam, and deciduous grouping (Table 21). Overall, the analysis indicated that the volume in the timber harvesting land base was underestimated by approximately 13% based on a sampling error of 9.9% (95% probability level).

The THLB determination was conducted using the attribute-adjusted forest cover inventory (i.e. low site productivity netdowns were assessed using the adjusted site index values).

Table 21. Forest inventory adjustment factor table (THLB >30ys old)[5]

Species Grouping	Age Ratio	Height Ratio	Volume Ratio[1]	Volume Impact Ratio[2]
Spruce,Balsam,deciduous	0.701	0.944	1.603	1.428
Pine <=100yrs	1.188	1.126	0.843	1.275
Pine >100yrs	0.889	0.963	1.296	1.131
Wet belt Fir <=140yrs	1.154	1.046	1.190	1.335
Wet belt Fir >140yrs	0.707	0.797	1.303	0.786
Dry belt Fir	0.851	0.728	1.860	0.798

[1] Volume factor represents adjustments to volumes that took place after inventory heights and ages were adjusted.
[2] Volume impact ratio represent the overall volume impact of the set of adjustments (age, height and volume)

During the building of VDYP yield curves, the volume ratio in Table 21 was input as the VAF in BatchVDYP.

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[4] Initial data provided by Lloyd Wilson (Resource Information Forester. Kamloops Service Centre, MSRM and its appropriateness was verified by Gary Johansen (MSRM Victoria) and Tim Salkeld (MSRM Victoria) by email on Nov 30, 2004.

[5] Based on "Lillooet Forest District VRI Statistical Adjustment Addendum. April 2003" and Karen Jahraus' July 14/04 spreadsheet provided by Lloyd Wilson)

3.11 Existing Timber Volume Check

To verify that no errors were made in natural stand yield table aggregation and that no significant aggregation bias exists, the total volume of the current (starting) inventory using polygon-specific inventory volumes was compared to the volume derived using analysis unit yield tables. The results for existing natural (VDYP) AU's are shown in Table 22 by AU and in Table 23 by age class.

Table 22. Existing timber volume check by AU

AU	THLB Area (ha)	Volume derived from:		Difference From Inv		Comments
		Yield tables (AU)	Inventory	m3	%	
101	17,798	1,959,059	1,655,443	303,616	18.3%	Yield curves overestimate volume in the dry Fd AUs and underestimate it in the wet Fd and SBCH AU's. The TSA wide difference is less than 1%.
102	11,858	2,549,432	2,030,796	518,636	25.5%	
103	3,819	808,028	985,915	-177,887	-18.0%	
104	889	422,877	419,289	3,588	0.9%	
105	34,821	4,345,517	4,996,566	-651,049	-13.0%	
106	29,233	5,657,255	5,874,553	-217,298	-3.7%	
107	6,925	2,293,369	2,483,785	-190,416	-7.7%	
108	2,079	1,294,859	1,346,411	-51,552	-3.8%	
109	10,899	2,867,441	3,008,413	-140,972	-4.7%	
110	15,562	6,554,936	6,696,011	-141,075	-2.1%	
111	2,984	550,334	607,689	-57,355	-9.4%	
112	6,227	2,635,731	2,428,273	207,458	8.5%	
113	14,699	1,431,543	1,667,287	-235,744	-14.1%	
114	54,582	13,968,600	12,837,983	1,130,617	8.8%	
All VDYP	**212,375**	**47,338,981**	**47,038,416**	**300,565**	**0.6%**	

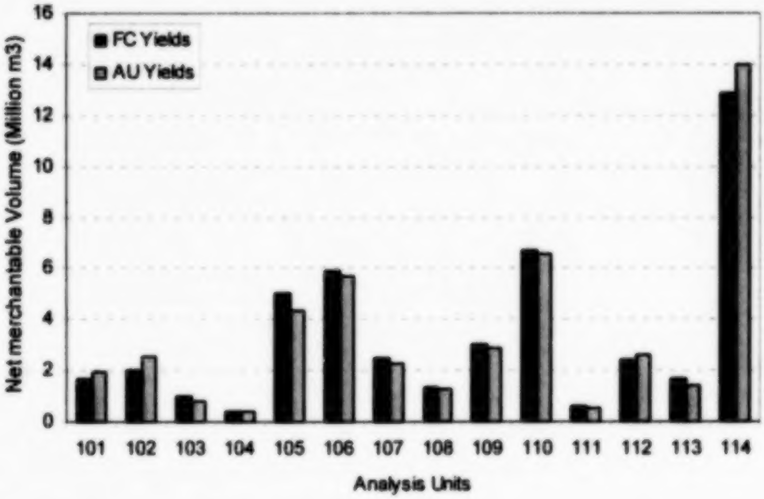

Figure 1. Net volumes by AU based on AU curves or forest inventory data

Table 23. Existing timber volume check by Age Class

Age Class	THLB Area (ha)	Volume derived from:		Difference From Inv		Comments
		Yield tables (AU)		M^3	%	
0-20	988	0	0	0	0.0%	Yield curves are underestimating volumes in immature stands and overestimating in very old stands.
21-40	4,360	15,334	21,306	-5,972	-28.0%	
41-60	5,277	184,189	236,474	-52,285	-22.1%	
61-80	12,964	1,180,620	1,336,261	-155,641	-11.6%	
81-100	21,842	3,439,111	3,894,325	-455,214	-11.7%	
101-120	58,652	12,967,284	12,066,669	900,615	7.5%	
121-140	37,897	9,341,587	9,362,938	-21,351	-0.2%	
141-250	69,076	19,555,349	19,556,131	-782	0.0%	
250+	1,319	655,507	564,312	91,195	16.2%	
All VDYP	**212,375**	**47,338,981**	**47,038,416**	**300,565**	**0.6%**	

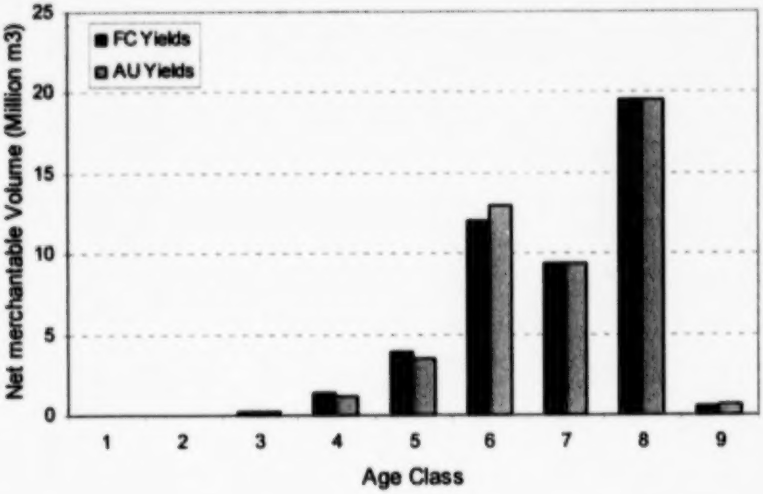

Figure 2. Net volumes by age class based on AU curves or forest inventory data

Overall, the volumes being generated from the AU yield tables correlated well with the inventory (<1% difference).

4.0 Silviculture

4.1 Silviculture management regimes

After harvest, stands in the TSA follow various silvicultural management regimes depending on originating stand type. Some stand types rely on natural regeneration while others rely on planting or a combination of the two. This section of the data package summarizes the silvicultural management inputs used in the TIPSY growth and yield model for each managed stand AU. Table 24 provides a summary of the inputs used in TIPSY to produce managed stands yield curves.

Table 24. Regeneration Assumptions (TIPSY inputs)

Existing AU#	Regen AU #	Description	Regen Method	Regen Species and Weighting (%)	Avg SI	Initial Density (stems/ha) (S1(1)/S2(2))	OAFs	Regen Delay (yrs)	Comments
Future Managed Stands									
101	1010	Fd Drybelt Selection <141	Natural	n/a	-	-	-	-	Remains on VDYP.
102	1010	Fd Drybelt Selection 141+	Natural	n/a	-	-	-	-	Remains on VDYP.
103	203	Fd Wetbelt G/M <141	Planted	Fd$_{80}$Pl$_{20}$	18.7	1000/1400	15/5	2	
104	204	Fd Wetbelt G/M 141+	Planted	Fd$_{80}$Pl$_{20}$	18.9	1000/1400	15/5	2	
105	205	Fd Wetbelt Poor <141	Planted	Fd$_{60}$Pl$_{40}$	12.5	1000/1200	15/5	2	
106	206	Fd Wetbelt Poor 141+	Planted	Fd$_{60}$Pl$_{40}$	11.8	1000/1200	15/5	2	
107	207	Sx/Bl/Cw/Hw G/M <141	Planted	Sx$_{70}$Pl$_{30}$	17.7	1200/1400	15/5	2	
108	208	Sx/Bl/Cw/Hw G/M 141+	Planted	Sx$_{70}$Pl$_{30}$	16.9	1200/1400	15/5	2	
109	209	Sx/Bl/Cw/Hw Poor <141	Planted	Sx$_{70}$Pl$_{30}$	12.3	1000/1200	15/5	2	
110	210	Sx/Bl/Cw/Hw Poor 141+	Planted	Sx$_{70}$Pl$_{30}$	11.1	1000/1200	15/5	2	
111	211	Pl Good/Med <101	Planted	Pl$_{90}$Sx$_{10}$	17.8	1400/1200	15/5	2	
112	212	Pl Good/Med 101+	Planted	Pl$_{90}$Sx$_{10}$	17.9	1400/1200	15/5	2	
113	213	Pl Poor <101	Planted	Pl$_{100}$	12.7	1200	15/5	2	
114	214	Pl Poor 101+	Planted	Pl$_{100}$	12.2	1200	15/5	2	
Existing Managed Stands									
501	601	Man - Fd Wetbelt G/M	Planted	Fd$_{80}$Pl$_{20}$	17.4	1000/1400	15/5	2	Uses same species and densities as future managed stands.
502	602	Man - Fd Wetbelt Poor	Planted	Fd$_{60}$Pl$_{40}$	12.5	1000/1200	15/5	2	
503	603	Man - Sx/Bl/Cw/Hw G/M	Planted	Sx$_{70}$Pl$_{30}$	15.6	1200/1400	15/5	2	
504	604	Man - Sx/Bl/Cw/Hw Poor	Planted	Sx$_{70}$Pl$_{30}$	12.0	1000/1200	15/5	2	
505	605	Man – Pl G/M	Planted	Pl$_{90}$Sx$_{10}$	16.5	1400/1200	15/5	2	
506	606	Man – Pl Poor	Planted	Pl$_{100}$	11.8	1200	15/5	2	
Pulpwood Agreement Stands *(used in sensitivity analysis only)*									
801	801	PA - Fd Drybelt Selection	Natural	n/a	6.9	-	-	-	Remains on VDYP.
802	902	PA - Fd Wetbelt	Planted	Fd$_{60}$Pl$_{40}$	7.8	1000/1200	15/5	2	Pulpwood Agreement Analysis Units – uses poor site assumptions.
803	903	PA - Sx/Bl/Cw/Hw	Planted	Sx$_{70}$Pl$_{30}$	5.4	1000/1200	15/5	2	
804	904	PA - Pl	Planted	Pl$_{100}$	7.3	1200	15/5	2	
805	905	PA - Deciduous	Planted	Pl$_{100}$	13.0	1200	15/5	2	

(1) S1: Species 1

(2) S2: Species 2

Clear cutting followed by planting was the dominant silvicultural regime modeled in the analysis. The only exception was within Douglas-fir dry belt stands (AUs 101/102 and 801). In these areas, a selection silvicultural regime was implemented that removed 40% of the volume on the first entry and then removed 30% of the available volume at each subsequent entry. Entry's were allowed to occur every 30 yrs once the stand had reached minimum harvest age for the first time. This selection silvicultural system occurs on 29,656 ha of the THLB (11.8%). This modelling approach is similar to that used in TSR2 but allows harvest volume to reflect the actual age of the stand at harvest.

4.2 Regeneration delay

Regeneration delay is the time between harvesting and the time when stand regrowth begins. The delay incorporates both the time taken to establish a stand, and the age of seedling stock planted, if applicable.

Based on current operations, licensees and MOF staff felt that the 2-year delay used in TSR2 was still an appropriate average regeneration delay applicable to all analysis units.

Regeneration delay was included in the growth and yield model (TIPSY) so published yield tables directly reflect the 2 year delay (Appendix D).

4.3 Stand rehabilitation

No stand rehabilitation is currently occurring in the TSA. No rehabilitation of problem forest types or non merchantable types was modeled. Pulpwood agreement stands are not included in the THLB and thus are not logged in the base case. When they are logged in the sensitivity analysis, they are assumed to be rehabilitated into the regular THLB under 'poor' site class regen assumptions.

4.4 Gene resources — use of select seed

As required by the Forest Practices Code, the TSA uses the best genetic quality seed and vegetative material available for regeneration. This section describes the yield adjustments used in this analysis to account for the use of select seed (i.e., orchard & superior provenance seed with a known genetic gain as measured by Genetic Worth [GW]).

SPUs are polygon features that geographically delineate the appropriate area of seedling use for stock originating from specific seed orchards throughout the province. Each SPU identifies the area and elevation range in which seedlings of a given orchard may be used in regeneration. The SPUs relevant in the Lillooet TSA are shown in Table 25. Estimates of future genetic worth and seedling availability are provided at the SPU level in Table 26.

Table 25. Seed Planning Units within the Lillooet TSA (Class A seed)

Species	Genetic Class "A" Seed Planning Zone	Seed Planning Unit	Elevation Band
Spruce	Thompson Okanagan (TO)	Sx TO High Sx TO Low	High (> 1300 m) Low (< 1300 m)
Lodgepole pine	Thompson Okanagan (TO)	Pli TO High Pli TO Low	High (> 1400 m) Low (< 1400 m)
Douglas-fir	Submaritime Coastal (SM)	Fd SM Low	Low (< 1300 m)

Table 26. Seed Planning Units (Class A Seed) genetic worth and seed availability

SPU	THLB Area (ha)	Percent of Total THLB	Genetic Worth Achieved (2004 Spar)	Percent Class A Seedlings (2004 Spar)	Planned GW for 2005	Planned Class A Seed Availability for 2005	Projected Future Genetic Worth % (2015)	Projected Class A Seed Availability (2015)
Sx TO High	221,797	89%	7	73%	9	100%	1	100%
Sx TO Low	7	0%			9	100%	18	100%
Pli TO High	40,412	16%	3	2%	11	17%	15	69%
Pli TO Low	53,617	21%			9	20%	13	82%
Fd SM Low	3,305	1%	0	0%	2	45%	8	100%

* Values obtained from 2004 species timelines as provided by Tree Improvement Branch in Dec 2004. Availability measured using 5 year average seedling requests to SPAR and total production levels shown on the species timelines.

A net GW applicable to each SPU was calculated using the values shown above for 2005 (GW% x Avail%). Current use (2004) of improved (select) seed is less than predicted by timelines for 2005 but this was felt to be offset by the increased gains projected into the future (between 2005 and 2015).

These values were then simplified to the species level by prorating the SPU values using THLB area.

In both base cases, existing managed stands did not receive any adjustment reflecting improved seed use. Although the Lillooet TSA has been using improved seed since 1990 (*Dwayne Eastman, MoF, personal communication*), the majority of stands would not have been established with improved seed. There will be a slight underestimation of timber supply in the future because these stands were modeled with no GW gains over the planning horizon.

In both base cases, future managed stands received the 2005 net GW's for Sx (8.0%), Pl (0.7%), and Fd (0.0%).

Genetic gains were incorporated into the growth and yield curves through TIPSY model functionality. When Sx, Pli, or Fd were included in a managed stand AU, its associated Net GW was input into TIPSY. This net GW reflects the average genetic gain associated with ALL seedlings of a given species planted in a typical year and are shown in Table 27. Where surrogate species were used in TIPSY, the GW employed is prorated to reflect the relative GW's of the original species (Sx used for Bl but Sx GW not applied to Bl proportion)

No increase in genetic worth was implemented during the planning horizon. This likely results in an underestimation of long term timber supply but was done because long term projected gains have yet to be proven.

Table 27. Net genetic worth by species to be applied in timber supply model

Time Horizon in Model (yrs)	Species	Genetic Gains applied in TIPSY For Both Base Cases	
		Existing Managed Stands	Future Managed Stands
1-250	Fd	0%	0.0%
1-250	Pl	0%	0.7%
1-250	Sx	0%	8.0%

4.5 Silviculture History (defining existing managed stands)

For growth and yield application, stands are classified into two categories based on their silviculture regime: natural stands and managed stands. Natural stands typically regenerated naturally and have no prior silviculture treatments that would have ensured full stocking and a good distribution of stems. Managed stands have had previous silviculture treatments and are assumed to be full stocked and well distributed.

In the previous Timber Supply Review District silviculture staff and licensees input suggested that stands <21 years of age were all in a managed condition and that a portion of the stands less than 40 years old would also be in a managed state. For the purposes of this analysis, District staff have indicated that all stands under 28 years should be treated as managed stands.

The area considered managed and natural is summarized in Table 28

Table 28. Managed and natural stand area

Silviculture Regime	Definition	THLB (ha)
Natural	100 series AU's *	212,375
Managed	500 series AU's	38,051
Total		**250,426**

* 800 series AU's are also considered natural but are only relevant in the pulpwood agreement sensitivity analysis.

4.6 Backlog and current not satisfactorily restocked areas (NSR)

Backlog NSR is any area that was denuded prior to 1987 (when basic silviculture became the obligation of licensees) and is not yet fully stocked. All other NSR areas are considered current NSR. Current NSR was assigned to existing managed stand analysis units and any delay in restocking these sites was reflected in the regeneration delay's assigned to these analysis units. These sites have either been reforested but are not yet confirmed in the inventory file, or will be reforested because licenses are under a legal obligation to do so.

The Cascades Forest District indicates that there are only 2,144 ha of NSR lands. Ed Nedokus, Forest Stewardship Officer, Cascade Forest District checked all polygons identified as backlog NSR with recent data sources. He concluded that there was currently no backlog NSR. (*Ed Nedokus, pers. comm. 18 Aug 2004*)

4.7 Incremental Silviculture and Commercial Thinning

In the Lillooet TSA no incremental silvicultural practices such as fertilization have or are occurring. In addition, no commercial thinning has or is occurring.

5.0 Timber harvesting

5.1 Minimum harvestable age / merchantability standards

In order for a stand within the timber supply model to be considered for harvesting, it must achieve a minimum harvest age that ensures it meets reasonable economic criteria and emulates what is generally current practice by forest licensees. Note that these are minimum criteria, not the actual ages at which stands are forecast for harvest. Some stands may be harvested at the minimum thresholds to meet forest-level objectives while other stands may be not be harvested until well past there "optimal" timber production ages due to management objectives for other resource values such as requirements for the retention of older forest, or ungulate winter range.

For this analysis, minimum harvestable ages were defined using the following criteria:

- Existing stands: Current practice follows the regional standard of 80 yrs for Douglas-fir or pine stands, and 100 yrs for all other coniferous stands.
- Future stands: Minimum harvest age is based on the length of time required for each AU to reach 90% of maximum mean annual increment or culmination (CMAI).

The minimum harvest age to be utilized for each analysis unit is defined in Table 29. For a detailed description of all analysis unit definitions, see Table 17.

Table 29. Minimum harvest ages

Existing Stands			Future Stands		
AU #	**AU Description**	**Min Harvest Age**	**AU #**	**AU Description**	**Min Harvest Age**
101	Nat - Fd Drybelt Selection <141	100			
102	Nat - Fd Drybelt Selection 141+	100			
103	Nat - Fd Wetbelt Good/Med <141	80	203	Fut Man -Fd Wetbelt Good/Med <141	77
104	Nat - Fd Wetbelt Good/Med 141+	80	204	Fut Man -Fd Wetbelt Good/Med 141+	77
105	Nat - Fd Wetbelt Poor <141	80	205	Fut Man -Fd Wetbelt Poor <141	102
106	Nat - Fd Wetbelt Poor 141+	80	206	Fut Man -Fd Wetbelt Poor 141+	109
107	Nat - Sx/Bl/Cw/Hw G/M <141	100	207	Fut Man -Sx/Bl/Cw/Hw Good/Med <141	69
108	Nat - Sx/Bl/Cw/Hw G/M 141+	100	208	Fut Man -Sx/Bl/Cw/Hw Good/Med 141+	73
109	Nat - Sx/Bl/Cw/Hw Poor <141	100	209	Fut Man -Sx/Bl/Cw/Hw Poor <141	101
110	Nat - Sx/Bl/Cw/Hw Poor 141+	100	210	Fut Man -Sx/Bl/Cw/Hw Poor 141+	112
111	Nat - Pl Good/Med <101	80	211	Fut Man -Pl Good/Med <101	56
112	Nat - Pl Good/Med 101+	80	212	Fut Man -Pl Good/Med 101+	55
113	Nat - Pl Poor <101	80	213	Fut Man -Pl Poor <101	76
114	Nat - Pl Poor 101+	80	214	Fut Man -Pl Poor 101+	78
801	PA - Fd Drybelt Selection	150	901	Man - PA - Fd Drybelt Selection	150
802	PA - Fd Wetbelt	150	902	Man - PA - Fd Wetbelt	150
803	PA - Sx/Bl/Cw/Hw	140	903	Man - PA - Sx/Bl/Cw/Hw	140
804	PA - Pl	100	904	Man - PA - Pl	100
805	PA - Deciduous	80	905	Man - PA – Dec (Pl regen)	80
502	ExMan - Fd Wetbelt Good/Med	79	602	FutMan - Fd Wetbelt Good/Med	150
503	ExMan - Fd Wetbelt Poor	102	603	FutMan - Fd Wetbelt Poor	102
504	ExMan - Sx/Bl/Cw/Hw Good/Med	82	604	FutMan - Sx/Bl/Cw/Hw Good/Med	80
505	ExMan - Sx/Bl/Cw/Hw Poor	108	605	FutMan - Sx/Bl/Cw/Hw Poor	104
506	ExMan - Pl Good/Med	59	606	FutMan - Pl Good/Med	59
507	ExMan - Pl Poor	82	607	FutMan - Pl Poor	82

5.2 Harvest systems

The steep terrain in the Lillooet TSA requires various harvesting methods. To better address the operational issues inherent on the TSA, a split between conventional and cable harvesting methods was made at a slope break of 40 percent. This delineation will not be used directly in the TSR but is available for reporting purposes.

5.3 Harvest Priorities

Harvest priorities established in the timber supply model will guide the model to harvest specific stands before others. In the previous TERP analyses, the timber supply model was set to harvest the oldest stands first. This deviated from the TSR 2 analysis, which used relative oldest first. In the AAC Rationale the Chief Forester contends that a more realistic approach would be somewhere between relative oldest first and a random ordering approach.

For the purpose of this analysis, a relative oldest first harvest pattern was selected. Under this harvest pattern stands that have the largest difference between their minimum harvest age and their current age are prioritized first. In addition to this basic priority, FDP blocks were treated as described below.

5.4 Forest Development Plan

The consolidated forest development plan (FDP) created for the TERP analysis was used to identify blocks that should be logged at the start of the harvest forecast. This "consolidated" forest development plan only contained those attributes that were necessary for timber supply and further work is needed to produce a truly consolidated FDP. For example, it does not contain all of BCTS development blocks. FDP linework and data was received from all licensees, specifically: Ainsworth, Teal Jones Group, Lytton Lumber and BC Timber Sales. Each licensee's data was provided in various data formats, level of detail and scope. From this data a basic consolidation was completed. Each licensee's blocks were classified as Logged, Approved, or Proposed. Any data prior to 1998 was removed from the FDP data since the last forest cover update occurred in that year.

During modelling, approved and proposed FDP blocks were given the highest harvest priority in the model.

5.5 Pulpwood Agreements

Overlapping the Lillooet TSA is pulpwood agreement 16 (PA 16). It was established in April 1990 and is expected to expire in 2015 (25-year non-replaceable license). PA 16 is an agreement that applies to a fixed area that allows harvesting of up to 25,000 m^3/yr in the Lillooet TSA from stands not included in conventional merchantability limits. Mills can access these stands if fiber residues suitable for the facility are not otherwise available. An electronic copy of the agreement is available on the Ministry of Forests Resource Tenures and Engineering Branch web site at
http://www.for.gov.bc.ca/dmswww/pa/PA%2016/PA%20No%2016%20Apr%2026%201990.pdf

Currently no volume has been billed under the PA 16 agreement in the Lillooet TSA. As such, current practice would suggest that no volume under PA 16 is expected. The base case will exclude PA 16 from the timber harvesting land base but a sensitivity analysis will include PA 16. The 800 series analysis units represent the PA16 stands and are used only in the sensitivity analysis.

Pulpwood Agreement 2 also exists in the Lillooet TSA but no volume has been or is expected to be harvested under this agreement. It has not been included in the analysis in any way.

6.0 Natural Forest Disturbance

It is inevitable that natural disturbances will occur within the forests of the Lillooet TSA and the implications of these disturbances on forest ages classes and volumes is recognized in the timber supply analysis process. Natural disturbances are events caused by factors such as wildfire, wind, snowpress, insects, disease and other forest health considerations. Two approaches to addressing these issues are used during modeling; one on the THLB and one on the remainder of the forested area of the TSA.

6.1 Unsalvaged Losses on the THLB

The purpose of this section is to quantify the average annual volume of timber that, in the future, will be damaged or killed on the THLB and not salvaged or accounted for by other factors. This factor is meant to capture catastrophic natural events like the fires that occurred in the Lillooet TSA in 2003 and 2004. Endemic pest losses are dealt with through factors applied in the growth and yield models as noted below:

> **TIPSY:** Operational Adjustment Factors reduces gross volumes to account for losses toward maturity such as decay, and endemic forest health issues like minor infestations.
> **VDYP:** The model predicts actual average yields from appropriate inventory ground plots. Endemic losses are inherently recognized in the model data.

Expected non-recoverable losses are summarized in Table 30. This volume was added to the annual harvest target in order to remove this volume from the land base and cause an appropriate amount of stand area to have its age set to zero. The unsalvaged loss volume is not included in reported harvest levels for the TSA.

Table 30. Non-recoverable losses

Cause of Loss	Annual Unsalvaged Losses (m^3)
Insects	4,134
Fire	12,746
Windthrow	8,200
Miscellaneous	1,000
Total	**26,080**

These values are the same as those used in TSR 2. Cascades Forest District has contracted a recalculation of non-recoverable losses and this data will be available for the AAC determination.

6.2 Disturbance in the non-THLB

As crown forested stands in the non-THLB contribute toward several forest cover objectives (i.e., landscape level biodiversity, visuals, etc.), it is important that the age class distributions in these stands remain consistent with natural processes. By implementing disturbance in these stands, a natural age class distribution can be maintained in the model and a realistic contribution toward seral goals ensured.

A constant area was disturbed annually in each LU/NDT combination. The amount of disturbance in each LU/NDT combination was based on the BEC variants present and their associated natural disturbance intervals and old seral definitions as outlined in the *Biodiversity Guidebook* (September 1995) and Table 31 below.

Using the negative exponential equation, the proportion of the forest that would typically occur as old seral forest can be calculated based on the disturbance interval (% area old = exp(-[old age / interval]). Using this % area in old, the calculation of an effective rotation age associated with this seral distribution was possible (Effective rotation age = interval / (1 – proportion old)). The effective rotation age can then be used to define an annual area of disturbance. For example, ESSF variants in NDT3 have a disturbance interval of 150 yrs and an old definition of 140 yrs. This translates into a typical age class distribution where 39% of the area is "old" (>140 yrs) and the oldest stands are around 246 years. Thus 1/246th of the area needs to be disturbed each year to maintain this age class distribution.

The base cases both included annual disturbance of the contributing Non-THLB area in each LU/NDT. The area target was achieved by randomly selecting stands to be disturbed in each period and then hardwiring this into the model. Stands of all ages had equal opportunity to be disturbed.

This method is a simplification of Option 4 in *Modeling Options for Disturbance Outside the THLB - Working Paper* (MoF, June 2003). Modeling of disturbance at the LU/BEC variant level was simplified to the LU/NDT level in order to minimize the number of modeled zones while ensuring that each zone would have a single, old seral age. No minimum amount of old was implemented because disturbance was selected randomly - independent of modeled harvest priority.

Table 31. Calculation of area to be disturbed annually in forested non-THLB by LU/NDT

BEC	NDT	Disturbance Interval (yrs)	"OLD" Defn (yrs)	% Area > OLD*	Effective Rotation Age (yrs)*	Contributing Non-THLB Area (ha)	Annual Area Disturbed (ha) (area/rot age)
ESSF/CWH	2	200	250	29%	280	42,142	150
MS/ESSF	3	150	140	39%	247	135,385	548
IDF/PP/BG	4	250	250	37%	395	98,917	250
Totals						**276,444**	**948**

* % area old = exp (-[old age / disturbance interval]), Effective rotation age = interval / (1 – % area old)

LU	Annual Area Disturbed (ha)	LU	Annual Area Disturbed (ha)	LU	Annual Area Disturbed (ha)
Bridge	36	Gun	38	Siska	44
Carpenter North	47	Hurley	43	Spruce Lake	62
Carpenter South	26	Kwoiek	31	Stein	136
Connel Creek	22	Lost Creek	22	Texas Creek	36
Duffey Lake	77	Murray	63	Watson Bar	74
French Bar	51	Pavilion	46	Yalakom	97

7.0 Integrated Resource Management

This section of the document describes the range of timber and non-timber management objectives that occur within the Lillooet TSA and how they will be addressed in the timber supply model. The most common method of inclusion is through the application of forest cover requirements.

Forest cover requirements can:

- Limit disturbance in an area by limiting the amount of forest that can be younger than a specific age (or shorter than a specific height);
- Maintain specific stand types on the land base by ensuring that at least a specified amount of forest older than a certain age (or taller than a certain height) is retained at all times;

Forest cover requirements from several different resource objectives can occur in a common area and result in overlapping constraints within the TSA. Each requirement is evaluated independently to ensure that the harvesting of a specific area does not violate any forest cover requirements.[6]

7.1 Lillooet Land and Resource Management Plan

The Lillooet LRMP process was initiated in 1995. A planning table consisting of varied interest groups was mandated with developing the LRMP. In March 2001 after 5 years of discussion and negotiation, the planning table submitted 2 land use options. The government at that time accepted one plan. However, with a change of government in 2001, the new government decided that further social and economic assessment was needed and that due to the polarized nature of the planning table, the Ministry of Sustainable Resource Management (MSRM) would take the lead in preparing a submission for cabinet.

On July 22, 2004 MSRM released an updated LRMP document that reflected recent changes in land-use planning policy. Earlier drafts were adapted to reflect new results based regulations by reducing descriptive/prescriptive material and the updated plan also rebalanced economic, social, and environmental themes in the LRMP. This new LRMP document is intended for use during First Nation's consultations. Discussions are ongoing and once concluded, changes may be made and submitted to Cabinet for review and approval.

As the LRMP may be approved by Cabinet at the time of the AAC determination, an LRMP base case has been prepared alongside the current practice base case. The differences between these two base cases are discussed throughout this document but are summarized here.

Table 32. LRMP timber supply related issues summary

Resource Issue	Modeled Difference from Current Practice Base Case
Protected Areas Strategy (PAS)	Eight additional protected areas have been identified. These areas will be removed from the timber harvesting land base but will still contribute to non-timber resource objectives.
Visual Quality Objective (VQO)	VQO's within Zone A (areas of high importance) will have disturbance limits applied. VQO polygons outside of this area (Zone B) will not be modeled.
Mule Deer Winter Range	LRMP specifies an allowable impact of 6000 ha of THLB. This was implemented through forest cover retention requirements applied to 'planning cells'.
Moose Habitat	Disturbance limits and retention requirements will be applied.
Mountain Goat Habitat	Escape terrain retention requirements will be applied.
Elk Habitat	Disturbance limits and retention requirements will be applied.

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[6] Where a minimum amount of forest is required and does not exist, some harvesting may still occur if there are any stands old enough for harvest once the oldest available stands have been set aside to meet the objective.

Resource Issue	Modeled Difference from Current Practice Base Case
Bighorn Sheep Habitat	Retention targets for early and late seral cover will be applied.
Grizzly Bear Habitat	LRMP specifies an allowable impact of 8000 ha of THLB. This was implemented by preventing harvest on 8000 ha of THLB considered the highest value habitat.
Spotted Owl	LRMP specifies an allowable impact of 5000 ha of THLB. This was implemented by applying cover constraints to the LTACs. Cover constraint is almost identical to that used in the Current Practice base case.

7.2 Green-up/adjacency

Green-up requirements specify that a logged block must achieve a specific condition called green-up before adjacent areas can be logged. Green-up refers to the average height of the regenerating forest reaching a specified target. Green-up requirements can often be waived if licensees manage for patch size distributions consistent with biodiverstiy objectives as described in the Landscape Unit Planning Guide (MoF/MoE 1999). Modeling of green-up requirements was done using forest level objectives, as opposed to block specific objectives, because this was consistent with the operational flexibility afforded by patch size management.

The amount of THLB area less than 3m in height was limited to 33% within each landscape unit (refer to Table 33). This is consistent with the objective applied in TSR2 and is applied in both TSR3 base cases.

Table 33. Green-up requirements

Management Zone	Green-up Requirement	Modeled Green-up Constraint	Area to which it applies
Integrated Resource Management Zone	3 m tall trees	Max 33% < 20 yrs within each LU	THLB area within each LU

Age to green-up was determined by calculating a weighted average stand type for the entire THLB and then evaluating the age/height relationship for the stand in SiteTools. This resulted in a Fd leading stand with an average site index of 13.1 – giving an 18 yr greenup period. A two year regen delay was added to this value.

7.3 Visual resources

The management of visual resources is based on visual quality objectives assigned to specific areas of the land base. The assignment of these objectives varies between current practice and the LRMP base case.

Current Management:

Current visual management utilizes a set of management polygons that are comprised of District Manager established VQO's (~70%) and Scenic Areas with recommended VQO's (~30%). The Scenic Areas will be modeled because licensees are currently managing for these VQO levels and they have been shown on recent development plans (*Pers Comm, Peter Rennie, MoF*). These scenic areas were modeled in TSR2 and will be grand-parented under FRPA's Forest Planning and Practices Regulation s9.1. Maximum disturbance levels appropriate for each VQO will be modeled for each VQO polygon as described in Table 34.

LRMP Management:

Visual management under the LRMP utilizes the same set of management polygons currently in use, plus additional areas along the Fraser River, classed as either Zone A or Zone B areas.

- Zone A – areas of high visual importance along paved travel corridors and adjacent to communities. These areas are to be managed as known scenic areas with established visual quality objectives and are modeled using maximum disturbance limits as shown in Table 34.
- Zone B – areas of moderate visual importance, or, areas where inventories have not been completed. The management in these areas will attempt to achieve the visual quality classes but

will not have established visual quality objectives so no constraints were applied during modeling. The additional scenic areas identified along the Fraser River fall into this category.

The maximum disturbance constraints were applied at the VQO polygon level and are identified in Table 34 (consistent with TSR2). These are mid-point values identified from the *Kamloops Land and Resource Management Plan VQO Matrix*. All CFLB stands within a given polygon were evaluated as part of the constraint.

Table 34. Modelling of visual management - current management and LRMP

VQO/VAC[1]	Disturbance Objectives			Current Practice		LRMP	
	Maximum Age	**Minimum Height**	**Maximum Disturbance**	**CFLB (ha)**	**THLB (ha)**	**CFLB (ha)**	**THLB (ha)**
P - Low	26	5	1%	0	0	0	0
P – Mod	22	4	2%	0	0	0	0
P – High	20	3	3%	0	0	0	0
R - Low	26	5	3.8%	7,128	1,003	3,387	450
R – Mod	22	4	5.5%	6,596	1,617	4,482	1,141
R – High	20	3	7.2%	45	31	45	31
PR – Low	26	5	10%	32,021	16,785	21,344	10,345
PR – Mod	22	4	14%	58,558	27,693	45,843	21,418
PR – High	20	3	18%	4,974	2,156	3,827	1,600
M – Low	26	5	17.5%	10,803	6,493	4,621	2,701
M – Mod	22	4	22.5%	18,296	8,957	13,081	5,780
M – High	20	3	27.5%	3,789	1,913	2,446	1,066
Totals				**142,210**	**66,648**	**99,076**	**44,532**

[1] VAC = visual absorption capacity, R = retention, PR = partial retention, M = modification

7.4 Range Resources and Management

In the Lillooet TSA, MOF Cascades Forest District staff believe that there is a low risk to timber supply resulting from cattle impacts (e.g., trampling of seedlings). While there are known instances where cattle have resulted in delays in the achievement of free-to-grow status, site specific issues currently are being addressed.

7.5 Recreation Resources

Forest cover retention within important recreation areas in the TSA was addressed through the netdown process and the application of forest cover retention for other values. Miscellaneous reserves and recreation areas identified in the ownership file (coded 61N and 69N) were completely removed from the working land base (see Table 3).

In addition, visually sensitive areas, riparian zones, UWR habitat areas, and community/domestic watersheds tend to overlap important recreation areas. The forest cover requirements on these zones help to accommodate recreational values. Thus, recreation resources did not have any specific additional forest cover objectives applied because other existing objectives were seen to adequately reflect current management for recreational values.

The LRMP does not implement any requirement for recreation or tourism that would affect timber supply. However, it does list sites for future consideration as priority *Land Act* reserves for long term public recreation use. These would be incorporated into future timber supply reviews if implemented.

7.6 Wildlife

The Lillooet TSA contains many wildlife species and other species at risk that are considered during forest management. The considerations under both the current management regime and the proposed LRMP management regime are outlined below:

7.6.1 Species of Concern / Identified Wildlife

The BC Conservation Data Centre (http://srmapps.gov.bc.ca/apps/eswp/) lists the conservation status of animals, plants, and plant communities. There are 33 animal species of concern whose distribution may extend into the Lillooet TSA. Some of these species have been designated as "Identified Wildlife" following the Identified Wildlife Guidebook (MoF 1999) and the May 2004 Ministerial order (http://wlapwww.gov.bc.ca /wld/documents/identified/approved_sar_order_list.pdf).

Scientific Name ANIMALS	**English Name**	**BC Status**	**Identified Wildlife**
Acipenser transmontanus pop. 4	White Sturgeon (Lower Fraser River pop.)	RED	
Aeronautes saxatalis	White-throated Swift	BLUE	
Antrozous pallidus	Pallid Bat	RED	
Ardea herodias herodias	Great Blue heron, *herodias* subspp	BLUE	
Ascaphus truei	Coastal Tailed Frog	BLUE	MAY 2004
Asio flammeus	Short-eared Owl	BLUE	MAY 2004
Botaurus lentiginosus	American Bittern	BLUE	
Buteo swainsoni	Swainson's Hawk	RED	
Colias occidentalis	Western Sulphur	BLUE	
Coluber constrictor	Racer	BLUE	
Crotalus oreganus	Western Rattlesnake	BLUE	
Danaus plexippus	Monarch	BLUE	
Euderma maculatum	Spotted Bat	BLUE	MAY 2004
Euphyes vestris	Dun Skipper	BLUE	
Falco mexicanus	Prairie Falcon	RED	
Gulo gulo luscus	Wolverine, *luscus* subspp	BLUE	MAY 2004
Limenitis archippus	Viceroy	RED	
Martes pennanti	Fisher	RED	
Melanerpes lewis	Lewis's Woodpecker	BLUE	MAY 2004
Myotis ciliolabrum	Western Small-footed Myotis	BLUE	
Myotis thysanodes	Fringed Myotis	BLUE	MAY 2004
Numenius americanus	Long-billed Curlew	BLUE	MAY 2004
Oncorhynchus clarki clarki	Cutthroat Trout, *clarki* subspp	BLUE	
Otus flammeolus	Flammulated Owl	BLUE	MAY 2004
Otus kennicottii macfarlanei	Western Screech-Owl, *macfarlanei* subspp	RED	MAY 2004
Pituophis catenifer deserticola	Gopher Snake, *deserticola* subspp	BLUE	MAY 2004
Salvelinus confluentus	Bull Trout	BLUE	
Salvelinus malma	Dolly Varden	BLUE	
Sphyrapicus thyroideus thyroideus	Williamson's Sapsucker, *thyroideus* subspp	BLUE	
Spizella breweri breweri	Brewer's Sparrow, *breweri* subspp	RED	
Strix occidentalis	Spotted Owl	RED	MAY 2004
Taxidea taxus	Badger	RED	MAY 2004
Ursus arctos	Grizzly Bear	BLUE	MAY 2004

The provincial *Identified Wildlife Management Strategy* provides for the creation of wildlife habitat areas (WHA) within the TSA, to protect key habitat features of listed wildlife species. No spatial land base deduction was implemented for Identified Wildlife because proposed WHA's were not yet official at the time of the analysis.

Provincial policy states that provincially the impact of the IWMS can be up to 1% of allowable annual cut. At the time of this analysis, no WHA's have been designated in the TSA, however it was recognized that an impact of up to 1% may be considered to account for the eventual deployment and establishment of WHA's. In this analysis, no reductions were incorporated to address the potential 1% impact for IWMS. The likely impact of IWMS can be discussed by the Chief Forester in his AAC rationale.

The LRMP objectives and strategies for species at risk are designed to supplement the general IWMS framework and provide specific management direction for white sturgeon, tailed frog, fisher, and bull trout. This management direction does not currently result in any timber supply impacts because WHA's have not been implemented, thus there is no difference between the current and LRMP base cases. The LRMP does require retention of large cottonwood trees in fisher habitat but all deciduous species have already been removed from contributing toward harvest volumes in this TSA. The LRMP provided detailed strategies with expected timber supply impacts for two identified wildlife species (grizzly bear and spotted owl) under separate sections (refer to separate sections below).

7.6.2 Grizzly Bear Habitat

Current forest practice does not specifically address grizzly bear management in the Lillooet TSA.

Under the proposed LRMP, a grizzly bear management allowance of 8000 ha is established. Specific direction for grizzly bear management requires reduced stocking standards/cluster planting in specific ecosystems and protection of critical habitats. For the purpose of modeling in the LRMP base case, 7942 ha of critical habitat in the THLB was selected using Tony Hamilton's (Forest Wildlife Biologist, MWLAP) capability mapping derived from broad ecosystem mapping (7809 ha of capability class 1 + 133 ha of class 2 in Texas watershed). This mapping is considered an interim surrogate for habitat ranking as the soon to be completed PEM based product will be more accurate. The areas removed from the land base are summarized by Grizzly priority watersheds in Table 35. These areas may not represent final management decisions but do represent the best available information at the time of analysis.

Table 35. Grizzly bear management assumptions (LRMP only)

Management Zone	**Management Requirement**	**Modeled Constraint**	**Netdown by Watershed (THLB ha)**	**Total Netdown (THLB ha)**
Grizzly Bear Habitat Areas	50m buffers around critical habitat features (forage, bedding, denning areas)	7942 ha of high priority habitat in the THLB was removed from harvest availability.	1. Texas 472 2. Spruce 0 3. Kwoiek 1237 4. Siska 0 5. Yalakom 107 6. Gun 174 7. Cadwallader 332 8. Hurley 1275 9. Cayoosh 666 10. Duffey 1259 11. McGillivray 1647 12. Lost Valley 683 13. Mud 68 14. Stein 0 15. French Bar 22 16. Watson Bar 0	7942 ha
	Reduced stocking / cluster planting in forage/berry producing site series			

7.6.3 Spotted Owl Distribution

The management of Spotted Owls in the Lillooet TSA was not considered in the Spotted Owl Management Plan approved by cabinet in 1997. Since 1997, a number of Spotted Owl locations and nesting sites have been identified in the Lillooet TSA and a new Spotted Owl recovery strategy is being prepared.

To immediately address these sites, 7 Spotted Owl long term activity centers (LTACs) have been drafted (Nelson Grant, MSRM 2003, pers. comm.) and management objectives have been proposed in the Lillooet LRMP. Currently, forestry activities are guided by a Memorandum of Understanding between the Lillooet TSA licensees and the MOF with the objective that harvesting in these areas will not reduce the structural value of these LTAC. Further to the MOU, a Spotted Owl Operational Plan was adopted in April 2004 and identifies specific cutting permits that can proceed within each of the LTAC's.

Under the proposed LRMP a THLB impact allowance of 5000 ha is established. Management objectives in the LRMP currently recommended that 67% of the forested lands in the LTAC's be at least 100 years at all times and nesting sites are buffered with reserves of sufficient size.

The LRMP management objectives are a simplification of the provincial Spotted Owl Management Plan guidelines that have been refined for the Lillooet TSA by John Surgenor (Wildlife Biologist, MSRM). These guidelines use 2 criteria to describe the minimum retention required within a long-term activity center: 67% of the area is to be in moderately suitable stands and 75% of this area in superior suitability stands. Class A (superior) stands are age class 8 or 9, height class >3, at least 10% fir or cedar or hemlock, crown closure >30%, and elevation less 1500 m; Class B (moderate) stands are similar to Class A except have an age class of 6 or 7. Unsuitable but capable stands are all other forested stands below 1370 m. MoF District staff have indicated that these guidelines represent current management for spotted owls in the TSA.

Table 36. Spotted owl management assumptions (both base cases)

Management Zone	Management Requirement	Modeled Constraint	CFLB Area (ha)	THLB Area (ha)
Spotted Owl LTAC's	**Current Management:** Manage as per refined Spotted Owl Management Plan guidelines in conjunction with MOU & Operational Plan.	Allow harvest of blocks named in 2004 Operational Plan. Min of 67% of CFLB in each LTAC > 100 yrs old plus, at least 3/4 of this area (50%) over 140 years old.	16,808	8,459
Spotted Owl LTAC's	**LRMP:** Maintain suitable old growth habitat within the LTAC's and provide a buffer around nesting sites.	Allow harvest of blocks named in 2004 Operational Plan. Min 67% of CFLB in each LTAC > 100 yrs old.	16,808	8,459

7.6.4 Elk Distribution

Approximately 100 elk currently exist in a small area in the south-east corner of the TSA.

Current forest practice does not specifically address elk habitat management.

Under the proposed LRMP, an elk habitat area is to be designated as "ungulate winter range" under the *Forest and Range Practices Act*. Specific management objectives are outlined for this area but they are not expected to impact timber supply so no THLB allowance was provided in the LRMP. The objectives that can be modeled in this analysis are shown in Table 37. The objectives that cannot be modeled limit opening size to 300m (one side) and specify that, if selection harvesting is used to create larger openings, retention levels should be least 40% of basal area.

Table 37. Elk habitat management requirements (LRMP only)

Management Zone	**Management Requirement**	**Modeled Constraint**	**Area to which it applies**
LRMP Elk – greenup	3 m tall trees	Max 33% < 21 yrs	CFLB area within the habitat area.
LRMP Elk – cover requirement	16m tall trees	Min 30% > 81 yrs	CFLB area within the habitat area.

Age to green-up was determined by calculating a weighted average stand type for the Elk zone and then evaluating the age/height relationship for the stand in SiteTools. This resulted in a Fd leading stand with an average site index of 12.8 – giving an 19 yr greenup period. A two year regen delay was added to this value. Using the same method, a height of 16m was translated into 81 yrs.

7.6.5 Moose Range and Management Units

Current forest practice does not specifically address moose habitat management.

Under the proposed LRMP, moose habitat areas are to be designated as "ungulate winter range" under the *Forest and Range Practices Act*. Within the broader moose habitat areas, high value sites have been identified as Moose Management Units (MMU's). Specific management objectives are outlined for both of these areas but they are not expected to impact timber supply and no THLB allowance was provided in the LRMP. The objectives to be modeled in this analysis are shown in Table 38.

Table 38. Moose habitat management requirements (LRMP only)

Management Zone	**Management Requirement**	**Modeled Constraint**	**Area to which it applies**
LRMP Moose Range	Max early seral forage opportunities	None	N/A
LRMP Moose Mgmt Units	67% > 4m tall trees	Min 67% > 20 yrs	CFLB area within each MMU and evaluated at the landscape unit level.

Age to green-up was determined by calculating a weighted average stand type for the area of MMU's and then evaluating the age/height relationship for the stand in SiteTools. This resulted in a Pl leading stand with an average site index of 13.9 – giving an 18 yr greenup period. A two year regen delay was added to this value.

7.6.6 Mountain Goat Escape Terrain

Current forest practice does not specifically address mountain goat management in the Lillooet TSA.

Under the proposed LRMP, winter/kidding ranges are to be designated as "ungulate winter range" under the *Forest and Range Practices Act*. Specific management objectives are outlined for these areas but they are not expected to impact timber supply and no THLB allowance was provided in the LRMP.

Under the LRMP, a Wildlife Management Area would be designated in the Cayoosh Range to ensure sustainable management of local goat herds while providing continued opportunities for resource development and commercial use. Development activities must be approved by WLAP. Because of the very small amount of THLB in this area, no special considerations were applied during modeling.

The objectives to be modeled in this analysis are shown in Table 39.

Table 39. Mountain goat habitat management assumptions (LRMP only)

Management Zone	Management Requirement	Modeled Constraint	Area to which it applies
LRMP Mountain Goat – winter/kidding range	Within a 200m buffer around escape terrain (>80% slope) in the winter/kidding areas, maintain at least 50% in old/mature and no more than 33% < 40 yrs.	Max 33% <40 yrs and Min 50% >100 yrs	CFLB area within escape terrain buffers grouped by LU.

The escape terrain coverage was created by Timberline by overlaying slopes greater than 80% with goat winter/kidding areas. A 200-metre buffer was then applied where these areas overlapped. The resulting buffered area represented escape terrain for mountain goats.

7.6.7 Mule Deer Winter Range

The Lillooet TSA does not currently have officially designated mule deer winter range. However, licensees and the MOF, as was identified in the previous timber supply review, do manage for mule deer winter range through operational practices (e.g., partial harvesting) in specific winter range areas.

Under the proposed LRMP, mule deer winter ranges are to be designated as "ungulate winter range" under the Forest and Range Practices Act. Specific management objectives are outlined for these areas and they are expected to impact timber supply. A 6000 ha THLB planning allowance was provided in the LRMP.

LRMP management objectives relevant to timber supply include the development of 200-800 ha planning cells over which an appropriate amount of snow interception cover will be maintained, and the retention of at least 5% of the basal area in a cutblock in the largest diameter Douglas-fir. The amount of cover required in the planning cells is dependant on the snowpack rating (moderate or low) for the planning cell. Within moderate snowpack areas, at least 33% of CFLB area in the planning cell must be in suitable habitat, while low snowpack areas require at least 15% suitable habitat in the planning cell. Suitable habitat for snow interception cover is defined as 140 year old stands with at least 46% crown closure (Douglas-fir stands preferred).

The objectives to be modeled in this analysis are shown in Table 40.

Table 40. Mule deer winter range management assumptions

Management Zone	Management Requirement	Modeled Constraint	Area to which it applies
Mule Deer Winter Range	5% basal area retention in all cutblocks using clumps of large Douglas-fir.	None – covered by WTP retention	N/A
	Moderate Snowpack zones: 33% snow interception cover in each planning cell	Min 33% > 140yrs	CFLB area within each planning cell.
	Low Snowpack zones: 15% snow interception cover in each planning cell	Min 15% > 140yrs	CFLB area within each planning cell.

For the purpose of modeling, Forsite created a planning cell coverage by splitting the existing MDWR polygons until they were in desired size range (200-800 ha). These planning cells were then overlaid on a snowpack rating coverage created using BEC variant mapping and LRMP definitions. Most planning cells fell within one snowpack rating (low or moderate) but where two occurred, the following logic was used:

- if moderate snowpack was < 10%, the entire cell was managed as low snowpack.
- If moderate snowpack was >=10%, a weighted average constraint was determined.
- If the weighted average constraint was less than 20% retention, 20% was used.

7.6.8 Bighorn Sheep Wintering Areas

Current management of big horn sheep in the Lillooet TSA does not impact timber supply.

Under the proposed LRMP, big horn sheep winter/lambing range areas are to be designated as "ungulate winter range" under the *Forest and Range Practices Act*. Specific management objectives are outlined for these areas but they deal primarily with non-forested areas. The LRMP states that "management for mule deer winter range provides adequate bighorn habitat in forested areas" so no constraints specific to bighorn sheep were modeled.

7.7 Plants

7.7.1 Species of Concern

The BC Conservation Data Centre (http://srmapps.gov.bc.ca/apps/eswp/) lists the conservation status of animals, plants, and plant communities. There are 42 plant species of concern whose distribution may extend into the Lillooet TSA.

Scientific Name **PLANTS**	**English Name**	**BC Status**
Allium geyeri var. *tenerum*	Geyer's onion	RED
Anagallis minima	chaffweed	BLUE
Apocynum x *floribundum*	western dogbane	BLUE
Astragalus lentiginosus	freckled milk-vetch	RED
Atriplex argentea ssp. *argentea*	silvery orache	RED
Bouteloua gracilis	blue grama	RED
Carex hystricina	porcupine sedge	BLUE
Carex incurviformis var. *incurviformis*	curved-spiked sedge	BLUE
Carex rupestris ssp. *drummondiana*	curly sedge	BLUE
Carex sychnocephala	many-headed sedge	BLUE
Carex vallicola var. *vallicola*	valley sedge	RED
Castilleja rupicola	cliff paintbrush	RED
Chamaesyce serpyllifolia ssp. *serpyllifolia*	thyme-leaved spurge	BLUE
Crepis atribarba ssp. *atribarba*	slender hawksbeard	RED
Crepis modocensis ssp. *rostrata*	western low hawksbeard	RED
Crepis occidentalis ssp. *pumila*	western hawksbeard	RED
Draba glabella var. *glabella*	smooth draba	BLUE
Hackelia diffusa	spreading stickseed	BLUE
Hutchinsia procumbens	hutchinsia	RED
Ipomopsis minutiflora	small-flowered ipomopsis	RED
Juncus albescens	whitish rush	BLUE
Juncus regelii	Regel's rush	BLUE
Lomatium triternatum ssp. *platycarpum*	nine-leaved desert-parsley	RED
Melica bulbosa var. *bulbosa*	oniongrass	RED
Melica spectabilis	purple oniongrass	BLUE
Muhlenbergia racemosa	satin grass	RED
Myosurus apetalus var. *borealis*	bristly mousetail	RED
Nicotiana attenuata	wild tobacco	RED
Pectocarya penicillata	winged combseed	RED
Poa abbreviata ssp. *pattersonii*	abbreviated bluegrass	BLUE
Polemonium elegans	elegant Jacob's-ladder	BLUE
Polemonium occidentale ssp. *occidentale*	western Jacob's-ladder	BLUE
Polygonum polygaloides ssp. *kelloggii*	Kellogg's knotweed	BLUE
Polystichum kruckebergii	Kruckeberg's holly fern	BLUE
Potentilla diversifolia var. *perdissecta*	diverse-leaved cinquefoil	BLUE
Potentilla nivea var. *pentaphylla*	five-leaved cinquefoil	BLUE
Potentilla paradoxa	bushy cinquefoil	RED
Ranunculus pedatifidus ssp. *affinis*	birdfoot buttercup	BLUE
Salix boothii	Booth's willow	BLUE
Scolochloa festucacea	rivergrass	RED
Sparganium fluctuans	water bur-reed	BLUE
Sporobolus compositus var. *compositus*	rough dropseed	RED

No specific measures were modeled to address the survival of these plant species as it is assumed that biodiversity objectives will be adequate.

7.8 Biodiversity

The *Landscape Unit Planning Guide* (LUPG), released in March 1999, consolidates policy direction and guidance on biodiversity management. The LUPG dictates that biodiversity be managed at both the landscape and stand levels. The primary mechanism for landscape-level management is retention of old and mature seral forest. Stand-level biodiversity is protected through retention of wildlife trees and wildlife patches. The following sections outline how retention of old and mature forest and wildlife trees/patches was be modeled.

7.8.1 Landscape Level Biodiversity

Within the Lillooet TSA, landscape level biodiversity is primarily managed through old-seral forest retention. Current management is guided by the provincial Old Growth Order (MoF 2004). This legislation specifies the required distribution and amount of old growth retention by ecosystem type and Biodiversity Emphasis Option (BEO). The retention is spread over the land base by requiring targets to be met in each landscape unit (LU) and biogeoclimatic ecosystem classification (BEC) variant. Each LU is assigned as BEO (Low, Intermediate or High) that dicates the level of retention required in each BEC variant. Old stands in the crown forest area (CFLB) of each unit were used to satisfy the old growth seral stage requirement . The Stein Valley Nlaka'pamux Heritage Park is an independent LU so it does not reduce the amount of retention required in areas where timber harvesting occurs.

The LRMP specifies old seral retention consistent with the Landscape Unit Planning Guide, which is consistent with the Old Growth Order, thus the LRMP base case will be model consistently with the Current Management base case.

Both the Current Management and LRMP base case will incorporate spatially defined old growth management areas (OGMA's) provided by Timberline Forest Inventory Consultants Ltd in Jan 2005. These OGMAs satisfy 100% of the required target levels in each LU-BEC variant level. No draw down in low BEO's was implemented during the creation of these OGMAs because no timber supply impacts were anticipated with the use of full targets. These OGMAs represent the most realistic implementation of the landscape biodiversity requirements on the land base and thus, harvesting of these areas was prevented for the duration of the planning horizon.

A sensitivity analysis was completed to explore the implications of modeling old seral requirements using percentage constraints.

The required amount of old seral retention within each LU-BEC variant can be found in Table 41.

Table 41. BEC/NDT old growth seral stage requirements

			% Old Requirement by Biodiversity Emphasis Option		
NDT	**Biogeoclimatic Zone**	**Minimum Age (years)**	**Low[1]**	**Intermediate**	**High**
2	CWH	250	9%	9%	13%
2	ESSF	250	9%	9%	13%
3	ESSF	140	14%	14%	21%
3	MS	140	14%	14%	21%
4	PP	250	13%	13%	19%
4	IDF	250	13%	13%	19%
4	BG	n/a	n/a	n/a	n/a

(1) In low Biodiversity emphasis units the option exists to achieve one third of the target percentage now and to meet the full target by the end of three rotations (approximately 240 years)

The boundaries of the 18 Landscape Units in the Lillooet TSA were approved and finalized in 2003. An area summary is provided in Table 42.

Table 42. Landscape units

Landscape Unit	LU No.	BEO*	Total Area (ha)	CFLB (ha)	THLB (Current)	THLB (LRMP)	OGMA Target	OGMA (ha)[x]
Bridge	11	Low	96,274	19,262	10,082	9,592	2,609	2,735
Carpenter Lake North	12	Low	56,836	33,360	18,740	18,740	4,445	4,466
Carpenter Lake South	13	Low$_{34}$ High$_{66}$	38,965	16,514	9,284	9,284	2,941	3,116
Connel Creek	14	Low$_{59}$ High$_{41}$	38,893	13,551	6,536	6,536	1,923	1,846
Duffey Lake	15	High	88,646	32,848	11,717	11,600	6,056	6,520
French Bar	16	Inter	42,080	29,347	14,667	14,377	3,386	3,246
Gun	17	Low	48,903	11,735	2,030	2,030	1,617	1,753
Hurley	18	Inter	72,809	22,474	11,081	10,979	2,754	3,004
Kwoiek	19	Inter$_{48}$ High$_{52}$	42,490	18,231	8,961	8,961	2,682	2,806
Lost Creek	20	High	27,529	11,694	5,107	5,107	2,330	2,418
Murray	21	Low	80,482	54,746	32,173	31,526	7,273	7,701
Pavilion	22	Inter	67,602	39,563	23,887	23,376	5,279	5,149
Siska	23	Inter	36,300	24,657	11,052	11,034	3,301	3,395
Spruce Lake	24	Inter	56,559	29,750	14,252	14,252	4,146	4,239
Stein	25	N/A	108,664	37,925	0	0	0	0
Texas Creek	26	Inter	54,287	20,070	9,487	9,487	2,700	2,706
Watson Bar	27	Low	88,539	62,577	39,366	38,913	8,251	8,171
Yalakom	28	Inter	79,142	49,792	21,977	17,340	6,193	7,615
Totals			1,124,999	528,096	250,427	243,160	67,886	70,886

* Percentages for split LU's are based on CFLB areas.

[x] OGMAs provided by Timberline Forest Inventory Consultants Jan 2005. Areas are slightly less than what occurred in original coverage because sliver removal eliminated some polygons flagged as OGMAs.

7.8.2 Stand Level Biodiversity — Wildlife Tree Retention

Wildlife tree retention is the primary method to address stand level biodiversity objectives. Section 3.2 and Appendix 3 of the *Landscape Unit Planning Guide* (March 1999) detail the process for determining wildlife tree retention requirements at the subzone level in order to establish LU objectives. On May 15, 2000, the Assistant Deputy Ministers of Forests and Environment, Lands and Parks approved changes to Section 3.2 of the *Landscape Unit Planning Guide*. Detailed policy on management of wildlife trees is provided in the document *Provincial Wildlife Tree Policy and Management Recommendations* (MoF/WLAP, February, 2000).

The practice of leaving wildlife trees (WT's) and patches (WTP's) will be modelled in the timber supply analysis by reducing yield curves to account for volume that is left in cutblocks that could otherwise have been harvested. This volume reduction was determined to be 5.8% (5.3% for patches and 0.5% for single trees) in TSR2 and is used again here. This assumption is the consistent in the two case cases and is applied to both existing and managed yield curves.

7.8.3 Coarse Woody Debris

Management of Coarse Woody Debris (CWD) is another important factor in the management of stand level biodiversity. As per provincial policy, it was assumed that CWD objectives are managed operationally within harvesting utilization standards.

7.8.4 Objectives for Patch Size Distribution

Patch size management has been utilized in the TSA in an effort to more closely mimic natural disturbance patterns and minimize fragmentation of the land base. Patch size management attempts to achieve the patch size distributions specified in the Landscape Unit Planning Guide (MoF/MoE 1999), and is an alternative to cut block adjacency green-up objectives. As stated in Section 7-2, cutblock green-up requirements (adjacency) are not modeled directly in this analysis because landscape level forest cover objectives are used to approximate these requirements. As patch management is also a spatial issue beyond the resolution of this timber supply analysis, the same landscape level objectives were used to approximate patch management requirements. Detailed spatial analyses completed during previous projects have confirmed that these landscape level forest cover objectives are often consistent with the flexibility associated with patch size management and the operational application of green-up requirements.

7.9 Community Watersheds

Twenty-one community watersheds are officially recognized within the Lillooet TSA. The district manager has directed that 2 additional watersheds be treated as community watersheds (Gun and Twall Creeks).

Current management of watersheds is in accordance with the Community Watershed Guidebook and associated Interior Watershed Assessment Procedure Guidebook. Harvesting is to avoid areas with very high surface erosion hazard, moderate to very high risk of sediment delivery, and high hazard for landslides. Watershed assessments must be completed in CWS's prior to harvesting and typically provide a range of indicators that reflect watershed health. One of these indicators, Equivalent Clearcut Area (ECA), is used as measure of the intensity and timing of forest disturbance. The management guidelines do not specifically identify objectives that represent forest cover constraints but rather defer to the judgment of professional hydrologists.

In order to limit timber harvesting within CWS's to realistic levels, the theoretical constraint developed and used in previous TSR's was applied again here (max 20% of stands under 6.6m tall). This is based on the assumption that 60% of each watershed has stands with a hydrological recovery reached at 9 m stand height and the remaining 40% of the watershed a 3 m stand height. An average stand reaches 6.6 m in about 33 years as such the implied rotation age is about 165 years under this constraint.

The LRMP does not specifically address community watersheds but does specify that resource development plans/activities are to "maintain ground and surface drinking water sources, including water quality, quantity, and timing of flow". Both base cases will be consistent for this issue.

Table 43. Community watershed management assumptions (both base cases)

Management Zone	Management Requirement	Modeled Constraint	Area to which it applies
Community Watersheds Plus Gun and Twall Creeks	Max equivalent clearcut area of 20% using a hydrologic recovery height of 6.6m tall.	Max 20% < 6.6m tall (33 yrs)	CFLB portion of each watershed.
Points of Diversion (water intakes) in community watersheds	Reserve zone of 100m applied upstream of CWS intake points (semi circle).	Removed during netdown.	Buffered areas upstream of CWS intakes.

A reserve zone upslope of community watershed intakes within defined community watersheds was also excluded from the timber harvesting land base. This reserve zone is model as a semi-circle with a radius of 100 m. This results in a gross area of 1.57 hectares for each community watershed intake within the TSA.

7.10 Lakeshore management zones

Lakeshore management zones have not yet been implemented in the Lillooet TSA because many of the lakes have yet to be classified. Management zones have been identified for 181 lakes and will be assigned visual quality objectives consistent with final lake classifications. An analysis completed in 2000 indicated that these LMZ's covered about 1700 ha of THLB.[7]

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[7] Peter Rennie (MoF Southern Interior Region - Landscape Forester). Email Nov 3, 2004.

8.0 Timber Supply Modeling

8.1 Timber supply model

This analysis was conducted using the Forest Planning Studio (FPS) timber supply model (v6.0.2.0) developed at UBC by Dr. John Nelson.

FPS is a forest estate simulation model designed to schedule harvests according to a range of spatial and temporal objectives (i.e. harvest flows, opening size, riparian buffers, seral stage objectives, etc.). Land base status, silviculture systems, rotation ages and growth and yield curves are assigned to each polygon in the model. At each time step, polygons are first ranked according to a set of harvest priorities (e.g. oldest first) and then harvested from this queue subject to constraints designed to ensure forest level objectives (e.g. seral stage targets) are achieved. Polygons are harvested until either the queue is exhausted or the periodic harvest target is met. At this stage the forest is aged to the next time period, and the process is repeated. At each time period, the model reports the status of every polygon in the forest estate.

While FPS-ATLAS is a spatially explicit timber supply model it is not the intention or objective of this analysis to produce a harvest schedule that can be implemented operationally. Little effort was invested in making logical harvest units or controlling block level spatial relationships for this analysis. The spatial aspects of the model have simply been used to visually verify model inputs and outputs. The spatial representation of the harvest schedule will only serve to identify eligible high priority (as defined in the model) harvest areas as they occur over the planning horizon.

Modeling was completed using 10 yr periods with all harvest occurring at period midpoints (yr 5, 15, 25...). This is an important consideration for short-term harvest levels because stand ages are interpreted for harvest eligibility at this midpoint year only, with the assumption that the volume harvested could be spread evenly out over the period. Using the start of the period would ensure that this was possible but would be unduly pessimistic because none of the stand growth/aging that occurs over the 10 yr period would be recognized. The use of the midpoint is considered to be a reasonable trade-off considering these issues. To ensure the feasibility of the harvest flow in the short term, a run was completed using single year periods and no significant difference in harvest flow was seen.

8.2 Harvest Flow Objectives

The harvest flow objective will be to gradually adjust harvest levels, if required, to arrive at the long-term harvest level (LTHL) for the TSA. A wide range of harvest flows are possible but the flows shown here reflect the following objectives:

- Achieve an acceptable short-term harvest level beginning at the current AAC whenever possible;
- Where harvest level changes are required, make steps no larger than 10%;
- Do not permit the mid-term harvest level to fall below a level reflecting the productive capacity of the TSA (based on VDYP yield estimates); and
- Achieve a maximum long-term stable harvest level over a 400-year time horizon reflecting the productive capacity of the TSA (based on TIPSY yield estimates). One indicator of a stable long-term harvest level will be a constant long-term total inventory (growing stock on the THLB).

8.3 Initial harvest rate

Both base case harvest forecasts used the following initial harvest rates:

Initial Harvest: 635,900 m^3/yr (current AAC) + Unsalvaged losses (26,080 m^3/yr) = 661,980 m^3/yr.

The modeled harvest flow begins with the current AAC (+NRL's) and does not include Pulpwood Agreement harvest volume because this area is not included in the THLB. Unsalvaged losses are included in the initial rate in order to reflect natural occurrences in the THLB (see section 6.1).

This initial harvest rate provides a starting point for the analysis. However, this initial level may change in order to achieve harvest flow objectives over the planning horizon.

8.4 Long Run Sustained Yield

Long run sustained yield (LRSY) values calculated on the basis of both natural and managed stand yield curves are shown in Table 44.

Table 44. LRSY values for natural and managed stands

Description	Current Management		LRMP	
	Natural	**Managed**	**Natural**	**Managed**
THLB (ha)	250,427	250,427	243,160	243,160
- Future roads (ha)	0	10,231	0	9,757
= Long term THLB (ha)	250,427	240,196	243,160	233,403
* Average MAI at culmination (m^3/ha)	1.75	1.93	1.75	1.93
= Theoretical Gross LRSY (m^3/yr)	**438,578**	**464,746**	**425,851**	**451,602**
- Wildlife tree patch retention (m^3/yr)	25,437	26,955	24,699	26,193
- Non-recoverable losses (m^3/yr)	26,080	26,080	26,080	26,080
= Theoretical Net LRSY (m^3/yr)	**387,060**	**411,711**	**375,071**	**399,329**

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Appendix C – Old Seral Retention Targets

Old Seral Retention Targets by Landscape Unit and BEC Variant - Lillooet TSA

								Old Seral		Spatial
LU #	**LU Name**	**BEO**	**BEC Variant**	**NDT**	**Total (ha)**	**THLB (ha)**	**CFLB (ha)**	**Target %**	**Target (ha)**	**OGMA (ha)**
11	Bridge	Low	AT dv	5	11,849	-	-	-	-	-
			AT dv i	5	13,062	-	-	-	-	-
			AT mw	5	5,620	-	-	-	-	-
			AT mw i	5	2,407	-	-	-	-	-
			ESSFdv 1	3	5,167	3,285	1,408	14%	460	470
			ESSFdv 2	3	6,699	4,241	1,097	14%	594	622
			ESSFdvp1	5	10,245	11	5	-	-	-
			ESSFdvp2	5	12,035	4	-	-	-	4
			ESSFdvw1	3	6,262	567	254	14%	79	77
			ESSFdvw2	3	6,473	320	24	14%	45	58
			ESSFmw	2	1,727	1,238	659	9%	111	129
			ESSFmwp	5	5	-	-	-	-	-
			IDF dk 5	4	4,956	2,371	1,644	13%	308	316
			IDF xh 3	4	39	-	-	13%	-	-
			MS dc 1	3	4,415	3,198	2,271	14%	448	418
			MS dc 2	3	959	666	178	14%	93	124
			MS mw	3	4,350	3,362	2,541	14%	471	517
Bridge Total					**96,270**	**19,262**	**10,082**		**2,609**	**2,735**
12	Carpenter Lake North	Low	AT dv	5	4,694	-	-	-	-	-
			ESSFdv 2	3	7,726	6,048	2,328	14%	847	802
			ESSFdvp1	5	2,106	31	6	-	-	-
			ESSFdvp2	5	1,961	2	-	-	-	1
			ESSFdvw1	3	2,202	610	109	14%	85	37
			ESSFdvw2	3	1,583	169	45	14%	24	86
			IDF dk 5	4	23,170	17,792	12,373	13%	2,313	2,280
			IDF xh 3	4	8,255	4,332	1,589	13%	563	605
			MS dc 2	3	5,139	4,377	2,290	14%	613	654
Carpenter Lake North Total					**56,836**	**33,360**	**18,740**		**4,445**	**4,486**
13	Carpenter Lake South	Low	AT dv	5	1,999	-	-	-	-	-
			ESSFdv 1	3	2,285	1,788	731	14%	250	260
			ESSFdvp1	5	1,888	44	-	-	-	6
			ESSFdvw1	3	1,302	566	20	14%	79	72
			IDF dk 5	4	4,775	2,220	1,591	13%	289	345
			IDF xh 3	4	74	-	-	13%	-	-
			MS dc 1	3	1,364	1,000	737	14%	140	179
		High	AT dv	5	4,040	-	-	-	-	-
			AT dv i	5	74	-	-	-	-	-
			ESSFdv 1	3	4,580	3,431	1,448	21%	721	770
			ESSFdv 2	3	112	55	37	21%	12	19
			ESSFdvp1	5	4,381	67	3	-	-	7
			ESSFdvw1	3	3,816	935	165	21%	196	225
			IDF dk 5	4	4,648	3,980	2,801	19%	756	760
			IDF xh 3	4	1,442	572	426	19%	109	119
			MS dc 1	3	2,096	1,817	1,294	21%	382	345
			MS dc 2	3	88	39	30	21%	8	9
Carpenter Lake South Total					**38,965**	**16,514**	**9,284**		**2,941**	**3,116**

								Old Seral		Spatial
LU #	LU Name	BEO	BEC Variant	NDT	Total (ha)	THLB (ha)	CFLB (ha)	Target %	Target (ha)	OGMA (ha)
14	Connel Creek	Low	AT dv	5	1,887	-	-	-	-	-
			AT dv i	5	59	-	-	-	-	-
			ESSFdv 1	3	707	260	92	14%	36	57
			ESSFdv 2	3	840	374	124	14%	52	52
			ESSFdvp1	5	1,500	5	-	-	-	1
			ESSFdvw1	3	1,408	100	11	14%	14	9
			ESSFmw	2	1,564	803	619	9%	72	40
			IDF dk 5	4	3,361	2,344	1,125	13%	305	267
			IDF xh 3	4	4,749	1,229	74	13%	160	163
			MS dc 1	3	587	414	309	14%	58	29
			MS dc 2	3	115	82	75	14%	11	-
			MS mw	3	1,054	776	440	14%	109	48
			IDF ww 2	4	3,607	1,055	768	13%	137	120
			MS xk 3	3	868	561	69	14%	79	136
		High	AT dv	5	952	-	-	-	-	-
			AT mw	5	741	6	-	-	-	-
			ESSFdvp1	5	435	-	-	-	-	-
			ESSFdvw1	3	302	50	25	21%	10	15
			ESSFmw	2	3,750	2,243	1,345	13%	292	305
			ESSFmwp	5	3,720	62	9	-	-	9
			IDF dk 5	4	906	780	258	19%	148	205
			MS mw	3	993	719	228	21%	151	146
			ESSFmww	2	1,857	529	126	13%	69	64
			IDF ww 2	4	2,930	1,158	839	19%	220	180
Connel Creek Total					**38,893**	**13,551**	**6,536**		**1,923**	**1,846**
15	Duffey Lake	High	AT dv	5	4,366	-	-	-	-	-
			AT mw	5	3,688	-	-	-	-	-
			AT mw i	5	56	-	-	-	-	-
			ESSFdv 1	3	16,253	10,145	2,781	21%	2,130	2,102
			ESSFdvp1	5	17,536	141	-	-	-	25
			ESSFdvw1	3	8,352	1,728	51	21%	363	371
			ESSFmw	2	8,961	6,311	3,386	13%	820	990
			ESSFmwp	5	4,679	14	-	-	-	3
			IDF dk 5	4	5,305	3,955	1,514	19%	751	709
			IDF xh 3	4	3,714	2,481	713	19%	471	578
			MS dc 1	3	5,909	4,274	1,314	21%	898	917
			MS mw	3	2,362	1,602	1,029	21%	336	451
			ESSFmww	2	6,108	1,040	45	13%	135	198
			CWH ms 1	2	1,359	1,157	882	13%	150	176
Duffey Lake Total					**88,646**	**32,848**	**11,717**		**6,056**	**6,520**
16	French Bar	Inter	MS xk 3	3	3,328	3,173	1,625	14%	444	345
			AT xv	5	415	-	-	-	-	-
			BG xh 3	4	2,184	-	-	13%	-	-
			BG xw 2	4	2,299	93	1	13%	12	-
			ESSFxv 2	2	14,030	12,261	5,567	9%	1,104	1,277
			ESSFxvp	5	1,143	48	6	-	-	-
			ESSFxvw	2	2,618	873	208	9%	79	56
			IDF dk 3	4	5,295	4,222	2,105	13%	549	505
			IDF xw	4	2,927	1,632	517	13%	212	290
			MS xv	3	7,843	7,046	4,637	14%	986	772
French Bar Total					**42,080**	**29,347**	**14,667**		**3,386**	**3,246**

								Old Seral		Spatial
LU #	**LU Name**	**BEO**	**BEC Variant**	**NDT**	**Total (ha)**	**THLB (ha)**	**CFLB (ha)**	**Target %**	**Target (ha)**	**OGMA (ha)**
17	Gun	Low	AT dv	5	10,766	-	-	-	-	-
			AT dv i	5	963	-	-	-	-	-
			ESSFdv 2	3	11,042	7,719	1,144	14%	1,081	1,121
			ESSFdvp2	5	15,152	85	6	-	-	13
			ESSFdvw2	3	7,354	1,108	48	14%	155	233
			IDF dk 5	4	1,575	1,356	388	13%	176	186
			MS dc 2	3	2,050	1,467	444	14%	205	200
Gun Total					**48,903**	**11,735**	**2,030**		**1,617**	**1,753**
18	Hurley	Inter	AT dv	5	3,423	-	-	-	-	-
			AT dv i	5	497	-	-	-	-	-
			AT mw	5	7,830	-	-	-	-	-
			AT mw i	5	566	-	-	-	-	-
			ESSFdv 1	3	7,331	4,568	1,340	14%	640	688
			ESSFdvp1	5	7,004	82	-	-	-	23
			ESSFdvw1	3	4,777	983	9	14%	138	164
			ESSFmw	2	9,610	6,437	2,348	9%	579	607
			ESSFmwp	5	11,905	37	1	-	-	2
			IDF dk 5	4	2,808	1,448	1,130	13%	188	206
			IDF xh 3	4	137	7	3	13%	1	-
			MS dc 1	3	8,582	6,229	4,651	14%	872	1,007
			MS mw	3	2,305	1,898	1,578	14%	266	248
			ESSFmww	2	6,034	783	20	9%	71	58
Hurley Total					**72,809**	**22,474**	**11,081**		**2,754**	**3,004**
19	Kwoiek	High	AT dv	5	1,144	-	-	-	-	-
			AT mw	5	1,340	-	-	-	-	-
			AT mw i	5	1,927	-	-	-	-	-
			ESSFdv 1	3	469	206	0	21%	43	20
			ESSFdvp1	5	1,010	-	-	-	-	-
			ESSFdvw1	3	905	130	7	21%	27	35
			ESSFmw	2	6,033	4,460	1,758	13%	580	647
			ESSFmwp	5	4,814	10	-	-	-	2
			MS dc 1	3	506	298	3	21%	63	76
			MS mw	3	3,117	2,408	1,530	21%	506	514
			ESSFmww	2	3,656	656	70	13%	85	132
			IDF ww 2	4	1,768	1,351	945	19%	257	253
		Inter	AT dv	5	146	-	-	-	-	-
			ESSFdv 1	3	1,260	794	402	14%	111	144
			ESSFdvp1	5	887	-	-	-	-	-
			ESSFdvw1	3	535	53	14	14%	7	13
			ESSFmw	2	1,236	782	504	9%	70	72
			IDF dk 5	4	2,202	1,843	1,232	13%	240	252
			IDF xh 3	4	2,374	1,192	636	13%	155	141
			MS dc 1	3	1,081	825	598	14%	115	105
			MS mw	3	1,297	1,043	526	14%	146	131
			ESSFmww	2	656	175	47	9%	16	15
			IDF ww 2	4	2,857	1,822	620	13%	237	231
			IDF dk 2	4	1	-	-	13%	-	-
			PP xh 2	4	1,270	185	68	13%	24	25
Kwoiek Total					**42,490**	**18,231**	**8,961**		**2,682**	**2,806**

								Old Seral		Spatial
LU #	LU Name	BEO	BEC Variant	NDT	Total (ha)	THLB (ha)	CFLB (ha)	Target %	Target (ha)	OGMA (ha)
20	Lost Creek	High	AT dv	5	3,704	-	-	-	-	-
			ESSFdv 1	3	5,605	3,309	1,336	21%	695	710
			ESSFdvp1	5	1,888	23	1	-	-	7
			ESSFdvw1	3	2,419	342	60	21%	72	96
			IDF dk 5	4	2,495	2,149	1,139	19%	408	407
			IDF xh 3	4	5,191	2,439	1,771	19%	463	194
			MS dc 1	3	1,039	800	283	21%	168	187
			MS mw	3	1,835	1,171	307	21%	246	202
			IDF ww 2	4	3,354	1,461	209	19%	278	616
Lost Creek Total					**27,529**	**11,694**	**5,107**		**2,330**	**2,418**
21	Murray	Low	IDF ww 2	4	888	335	294	13%	44	56
			MS xk 3	3	4,294	3,776	3,122	14%	529	519
			PP xh 2	4	13,971	6,928	721	13%	901	926
			BG xh 2	4	2,001	30	5	13%	4	-
			ESSFdc 2	3	1,282	883	258	14%	124	159
			ESSFxc	3	718	617	503	14%	86	65
			ESSFxc 3	3	615	449	295	14%	63	108
			ESSFxcp	5	43	11	0	-	-	2
			ESSFxcw	3	234	77	16	14%	11	33
			IDF dk 1	4	22,184	17,706	13,135	13%	2,302	2,501
			IDF xh 2	4	20,869	13,965	6,131	13%	1,816	1,824
			MS dm 2	3	7,986	5,534	4,215	14%	775	768
			MS xk	3	5,397	4,434	3,478	14%	621	739
Murray Total					**80,482**	**54,746**	**32,173**		**7,273**	**7,701**
22	Pavilion	Inter	MS xk 3	3	12,847	10,913	7,747	14%	1,528	1,289
			BG xh 3	4	2,724	98	6	13%	13	-
			IDF dk 3	4	3,012	1,756	1,455	13%	228	159
			IDF xw	4	712	239	41	13%	31	41
			PP xh 2	4	8,725	2,772	471	13%	360	306
			ESSFxc 3	3	3,705	2,807	1,642	14%	393	537
			ESSFxcp	5	732	31	4	-	-	3
			ESSFxcw	3	762	291	121	14%	41	61
			IDF dk 1	4	13,880	10,518	7,344	13%	1,367	1,358
			IDF xh 2	4	18,392	10,131	5,053	13%	1,317	1,394
			AT xc 3	5	241	-	-	-	-	-
			IDF xh 2a	4	1,870	6	3	13%	1	-
Pavilion Total					**67,602**	**39,563**	**23,887**		**5,279**	**5,149**
23	Siska	Inter	ESSFmw	2	198	71	-	9%	-	2
			ESSFmwp	5	83	-	-	-	-	-
			IDF xh 3	4	173	1	-	13%	-	-
			ESSFmww	2	162	23	1	9%	2	8
			IDF ww 2	4	390	343	265	13%	45	27
			IDF dk 2	4	7,552	5,983	3,377	13%	778	815
			PP xh 2	4	2,892	1,215	295	13%	158	160
			ESSFdc 2	3	7,512	5,298	1,691	14%	742	747
			IDF dk 1	4	238	225	193	13%	29	6
			IDF xh 2	4	9,359	6,046	2,463	13%	786	840
			MS dm 2	3	6,266	5,262	2,758	14%	737	766
			ESSFdcp	5	503	60	-	-	-	-
			ESSFdcw	3	936	130	8	14%	18	25
Siska Total					**36,265**	**24,857**	**11,052**		**3,294**	**3,395**

								Old Seral		Spatial
LU #	LU Name	BEO	BEC Variant	NDT	Total (ha)	THLB (ha)	CFLB (ha)	Target %	Target (ha)	OGMA (ha)
24	Spruce Lake	Inter	AT dv	5	3,938	-	-	-	-	-
			ESSFdv 2	3	7,105	6,185	1,865	14%	866	879
			ESSFdvp1	5	978	2	-	-	-	2
			ESSFdvp2	5	2,199	2	1	-	-	-
			ESSFdvw1	3	1,086	148	44	14%	21	28
			ESSFdvw2	3	2,020	383	32	14%	54	22
			IDF dk 5	4	1,226	1,026	609	13%	133	136
			MS dc 2	3	11,059	9,673	6,494	14%	1,354	1,389
			ESSFxc 3	3	13,440	11,567	5,199	14%	1,619	1,644
			AT xc 3	5	4,446	-	-	-	-	-
			AT xc	5	316	0	-	-	-	-
			ESSFxcp3	5	4,362	55	6	-	-	1
			ESSFxcw3	3	4,382	709	2	14%	99	139
Spruce Lake Total					**56,559**	**29,750**	**14,252**		**4,146**	**4,239**
25	Stein	n/a	AT dv	5	3,555	-	-	-	-	-
			AT mw	5	7,106	-	-	-	-	-
			AT mw i	5	1,871	-	-	-	-	-
			ESSFdv 1	3	18,221	11,397	-	0%	-	-
			ESSFdvp1	5	13,436	52	-	-	-	-
			ESSFdvw1	3	9,872	1,283	-	0%	-	-
			ESSFmw	2	9,568	6,557	-	0%	-	-
			ESSFmwp	5	11,261	72	-	-	-	-
			IDF dk 5	4	4,036	2,627	-	0%	-	-
			IDF xh 3	4	4,936	3,207	-	0%	-	-
			MS dc 1	3	4,243	2,942	-	0%	-	-
			MS mw	3	5,530	4,555	-	0%	-	-
			ESSFmww	2	10,543	2,009	-	0%	-	-
			IDF ww 2	4	2,667	2,228	-	0%	-	-
			CWH ms 1	2	849	632	-	0%	-	-
			PP xh 2	4	970	364	28	0%	-	-
Stein Total					**108,664**	**37,925**	**28**	-	-	-
26	Texas Creek	Inter	AT dv	5	2,239	-	-	-	-	-
			ESSFdv 1	3	11,211	6,770	2,700	14%	948	965
			ESSFdvp1	5	11,974	88	11	-	-	31
			ESSFdvw1	3	6,453	846	142	14%	119	165
			IDF dk 5	4	5,231	3,988	2,137	13%	518	432
			IDF xh 3	4	8,873	4,459	2,843	13%	580	582
			MS dc 1	3	3,808	2,574	1,171	14%	360	350
			PP xh 2	4	4,499	1,344	484	13%	175	180
Texas Creek Total					**54,287**	**20,070**	**9,487**		**2,700**	**2,706**

								Old Seral		Spatial
LU #	LU Name	BEO	BEC Variant	NDT	Total (ha)	THLB (ha)	CFLB (ha)	Target %	Target (ha)	OGMA (ha)
27	Watson Bar	Low	AT dv	5	415	-	-	-	-	-
			ESSFdv 2	3	2,746	2,172	1,286	14%	304	283
			ESSFdvp1	5	632	0	-	-	-	0
			ESSFdvw1	3	531	48	20	14%	7	17
			IDF dk 5	4	4,429	3,670	2,829	13%	477	555
			IDF xh 3	4	14,072	8,296	4,002	13%	1,078	1,086
			MS dc 2	3	1,150	957	679	14%	134	222
			MS xk 3	3	11,979	10,956	7,598	14%	1,534	1,452
			AT xv	5	196	-	-	-	-	-
			BG xh 3	4	5,416	95	7	13%	12	17
			BG xw 2	4	655	35	0	13%	5	-
			ESSFxv 2	2	3,367	3,273	1,381	9%	295	300
			ESSFxvp	5	380	8	4	-	-	2
			ESSFxvw	2	919	493	217	9%	44	52
			IDF dk 3	4	2,548	2,310	1,452	13%	300	417
			IDF xw	4	3,982	2,560	1,069	13%	333	263
			PP xh 2	4	5,400	2,072	241	13%	269	367
			ESSFxc 3	3	13,743	12,402	8,756	14%	1,736	1,538
			ESSFxcw	3	381	71	42	14%	10	8
			IDF dk 1	4	14,640	13,029	9,736	13%	1,694	1,587
			ESSFxcw3	3	680	129	48	14%	18	4
			ESSFxcp4	5	279	0	-	-	-	-
Watson Bar Total					**88,539**	**62,577**	**39,386**		**8,251**	**8,171**
28	Yalakom	Inter	AT dv	5	7,438	-	-	-	-	-
			ESSFdv 2	3	8,518	7,095	2,206	14%	993	1,045
			ESSFdvp1	5	5,953	95	1	-	-	29
			ESSFdvp2	5	239	104	21	-	-	-
			ESSFdvw1	3	2,760	627	78	14%	88	81
			IDF dk 5	4	3,406	2,503	1,752	13%	325	349
			IDF xh 3	4	4,982	3,553	1,553	13%	462	630
			MS dc 2	3	3,403	2,963	1,841	14%	415	412
			MS xk 3	3	6,480	5,686	2,853	14%	796	943
			AT xv	5	108	1	1	-	-	-
			ESSFxv 2	2	11,585	9,492	2,591	9%	854	1,429
			ESSFxvp	5	1,496	64	8	-	-	6
			ESSFxvw	2	4,070	1,845	227	9%	166	513
			PP xh 2	4	571	141	14	13%	18	9
			ESSFxc 3	3	4,509	3,806	1,670	14%	533	667
			ESSFxcw	3	310	57	6	14%	8	24
			IDF dk 1	4	12,045	11,196	7,065	13%	1,455	1,422
			AT xc 3	5	128	-	-	-	-	-
			ESSFxcw3	3	239	60	8	14%	8	-
			ESSFxcp4	5	93	1	-	-	-	-
			ESSFxc 4	3	808	504	85	14%	71	56
Yalakom Total					**79,142**	**49,792**	**21,877**		**6,193**	**7,815**
Grand Totals					**1,124,960**	**528,096**	**250,426**		**67,880**	**70,885**

Appendix D – Analysis Unit Volumes

Lillooet TSR3 Yield Curves

(As used in model - includes reductions for WTPs and RTLs where applicable)

	Existing Natural Stands (VDYP)														Future Managed Stands (TIPSY)											
Age	101	102	103	104	105	106	107	108	109	110	111	112	113	114	203	204	205	206	207	208	209	210	211	212	213	214
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
30	0	0	3	2	0	0	4	1	0	0	11	18	0	0	4	4	0	0	4	1	0	0	25	26	1	1
40	4	1	31	39	1	1	34	16	4	2	55	86	7	9	29	30	1	0	39	28	1	0	80	83	13	10
50	14	5	72	89	9	6	98	76	19	14	95	147	28	38	76	79	7	4	107	89	11	4	139	142	38	32
60	32	14	113	139	25	19	176	157	53	38	131	201	52	75	127	130	22	13	175	156	41	21	189	192	67	59
70	55	30	153	187	46	38	249	232	103	78	163	249	75	110	173	177	43	29	234	211	81	51	230	234	95	85
80	81	50	192	233	67	58	313	297	150	120	192	292	95	142	212	216	66	49	291	266	123	87	266	270	120	109
90	108	73	228	276	89	79	369	353	195	159	219	330	115	172	250	255	88	68	332	310	160	124	292	295	142	131
100	134	96	263	318	109	99	418	403	236	195	243	366	133	201	284	289	108	87	361	341	193	155	312	315	160	149
110	160	118	295	356	129	118	461	446	274	229	266	398	150	227	316	322	126	103	383	365	225	185	329	332	176	164
120	182	138	323	389	146	135	500	483	308	260	287	429	166	253	346	352	142	119	403	384	256	213	344	347	190	177
130	203	156	349	419	163	152	538	519	344	291	307	457	182	276	372	378	156	133	418	401	281	241	356	360	201	189
140	222	173	371	446	178	166	570	551	375	320	320	476	192	293	393	399	168	145	430	413	300	264	366	370	211	199
150	239	189	391	470	191	180	599	579	403	347	330	491	201	307	411	418	179	155	440	424	317	283	375	378	221	207
160	255	203	409	491	202	191	625	604	429	371	337	502	207	317	428	434	189	164	443	433	331	299	382	385	229	215
170	269	216	425	509	212	201	648	626	452	394	341	509	211	324	444	451	198	173	444	435	341	311	387	390	236	222
180	283	229	439	526	221	211	668	646	473	415	342	512	213	328	458	464	207	181	445	436	351	322	391	394	241	228
190	296	241	453	541	230	220	686	664	492	435	341	511	213	328	469	475	215	188	445	437	360	332	395	397	246	233
200	309	253	466	556	239	230	704	681	511	453	343	514	215	332	478	484	222	194	445	438	367	340	396	399	250	237
210	321	264	478	571	247	239	720	696	529	471	345	518	217	336	486	492	228	200	445	438	373	348	397	399	253	241
220	332	275	490	584	255	247	735	710	545	488	347	522	220	340	493	498	233	206	445	438	379	354	398	400	256	244
230	343	286	501	597	263	255	749	723	561	504	349	526	222	344	498	503	238	210	445	438	383	360	398	400	258	247
240	354	296	511	609	270	263	763	735	576	520	352	530	224	347	503	508	242	215	445	438	387	364	399	401	259	249
250	364	306	521	621	277	270	775	747	591	534	354	534	226	350	507	512	246	219	445	438	390	368	399	401	261	250
260	364	306	522	621	278	271	780	752	596	540	355	536	227	353	510	516	250	223	445	438	392	372	399	401	262	252
270	364	306	522	622	278	271	785	757	602	545	357	539	229	355	513	519	252	225	445	438	392	374	399	401	264	252
280	365	307	522	622	278	271	789	761	607	550	359	541	230	357	516	521	256	229	445	438	392	376	399	401	264	254
290	365	307	523	622	278	272	792	766	612	554	360	543	231	359	518	523	258	231	445	438	392	379	399	401	265	254
300	365	307	523	622	278	272	796	769	616	558	361	545	232	360	518	523	258	231	445	438	392	379	399	401	265	254
310	365	307	523	623	278	272	799	772	620	562	362	546	233	362	518	523	258	231	445	438	392	379	399	401	265	254
320	365	307	523	623	278	272	801	775	623	566	363	548	233	363	518	523	258	231	445	438	392	379	399	401	265	254
330	365	307	523	622	278	272	804	778	627	569	364	549	234	364	518	523	258	231	445	438	392	379	399	401	265	254
340	365	307	523	622	278	272	806	780	630	572	365	550	234	365	518	523	258	231	445	438	392	379	399	401	265	254
350	365	307	523	622	278	272	808	782	633	574	365	551	235	365	518	523	258	231	445	438	392	379	399	401	265	254

	Existing Managed Stands (TIPSY)						Future Managed Stands (TIPSY)						Existing PA16 Stands					Future PA16 Stands					Future Drybelt	
Age	501	502	503	504	505	506	601	602	603	604	605	606	801	802	803	804	805	901	902	903	904	905	1010	1011
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	1	0	1	0	14	1	1	0	1	0	15	1	0	0	0	0	0	0	0	0	0	1	0	0
40	17	1	10	1	57	7	18	1	14	1	59	7	0	0	0	0	5	0	0	0	0	17	0	0
50	55	7	51	7	108	26	55	7	59	8	110	27	0	0	0	0	18	0	0	0	0	44	0	0
60	97	21	105	28	154	49	98	21	119	35	157	50	0	0	0	3	38	0	0	0	1	77	0	0
70	141	40	160	64	193	75	142	41	173	73	196	76	1	1	0	11	65	1	0	0	6	106	0	0
80	178	63	206	102	225	98	178	64	220	113	228	98	2	3	1	23	88	2	1	0	13	131	116	0
90	210	85	250	140	254	118	210	86	269	150	258	119	5	6	2	37	111	5	3	1	20	153	134	0
100	241	105	290	171	277	136	241	105	305	183	280	136	10	12	4	51	131	10	6	2	30	172	134	120
110	269	124	320	201	294	152	269	124	332	213	296	152	17	20	12	66	147	17	9	6	39	188	160	136
120	294	139	342	231	306	164	294	140	354	245	309	165	24	27	25	80	160	24	15	14	47	201	182	136
130	318	153	360	258	318	175	318	153	369	270	320	176	31	35	41	94	170	31	21	24	56	213	203	156
140	340	165	375	280	329	186	340	165	384	292	331	187	38	41	58	105	178	38	26	38	64	224	222	173
150	358	176	387	298	337	194	359	176	396	308	340	195	45	47	74	115	185	45	31	53	71	233	239	189
160	375	187	398	313	345	201	376	187	406	322	347	202	51	53	89	122	188	51	37	69	78	241	255	203
170	389	195	406	325	351	208	390	195	414	334	353	209	57	58	104	128	190	57	43	84	84	248	269	216
180	402	203	413	336	356	214	402	203	420	344	358	215	63	63	119	132	192	63	48	100	90	253	283	229
190	413	211	419	345	361	219	413	212	423	352	362	220	68	67	132	135	193	68	53	115	95	257	296	241
200	424	218	422	353	364	224	424	219	424	360	365	224	73	71	145	138	195	73	57	128	99	261	309	253
210	433	224	422	360	367	228	433	224	424	367	367	229	78	75	158	141	197	78	61	141	103	263	309	253
220	442	230	423	367	369	231	442	230	424	373	369	232	82	79	170	145	198	82	65	154	107	266	309	253
230	449	235	423	372	371	235	449	235	424	377	371	235	86	83	182	148	200	86	69	166	110	268	309	253
240	455	239	423	376	372	237	455	239	424	381	372	237	90	86	193	150	201	90	72	179	113	270	309	253
250	460	243	423	380	373	239	460	243	424	384	373	239	94	89	204	153	203	94	75	191	116	271	309	253
260	465	247	423	383	374	241	465	247	424	387	374	241	95	89	213	155	203	95	78	204	118	272	309	253
270	469	250	423	386	374	242	469	250	424	388	374	242	95	90	221	157	203	95	81	214	121	273	309	253
280	472	252	423	387	374	243	472	252	424	388	374	243	95	90	229	159	203	95	83	224	123	274	309	253
290	475	255	423	387	374	244	475	255	424	388	374	244	96	90	236	160	203	96	85	233	125	275	309	253
300	475	255	423	387	374	244	475	255	424	388	374	244	96	90	243	162	203	96	85	233	125	275	309	253
310	475	255	423	387	374	244	475	255	424	388	374	244	96	90	250	163	203	96	85	233	125	275	309	253
320	475	255	423	387	374	244	475	255	424	388	374	244	96	90	256	164	203	96	85	233	125	275	309	253
330	475	255	423	387	374	244	475	255	424	388	374	244	96	90	262	164	204	96	85	233	125	275	309	253
340	475	255	423	387	374	244	475	255	424	388	374	244	96	89	268	165	204	96	85	233	125	275	309	253
350	475	255	423	387	374	244	475	255	424	388	374	244	96	89	273	166	204	96	85	233	125	275	309	253

Appendix E - Socio-Economic Analysis Background Information

Forest Industry Employment and Employment Income Estimation Methodology

Summary

Estimates of forest industry *direct* employment come from surveys of TSA licensees and timber processors about their harvesting, timber inputs and employment. The survey responses provide the basis for calculating direct employment per m^3 in harvesting and processing. The ratios are expressed as person-years (PYs) per '000 m^3 of harvested timber.

Estimates of forest industry *indirect and induced* employment come from multiplication of forest industry timber-based *direct* employment by indirect and induced employment multipliers that are calculated by BC Stats. The indirect and induced multipliers are assembled from information contained in the BC Government's Input-Output (I/O) model.

Employment and employment income

The employment estimates are based on licensee supplied information about their corporate and contractor employment. Employment is tied to timber harvested so the employment data provided by the licensees in the form of person-years (PYs) or full-time equivalents (FTEs) is divided by the volume of the licensee's harvest in the logging case and the volume of the wood processor's wood fibre input in the processing case. In so doing, the employment is expressed as an employment per 1,000 m^3 coefficient, which allows for a ready estimate of forest sector employment and income impacts based on timber harvest level changes.

The direct employment coefficients that were developed for the second Timber Supply Review (TSR2) were used in the employment estimations of this socioeconomic analysis.

For TSR2, BC MOF surveyed licensees and processors in the Lillooet TSA to obtain their employment numbers and their timber harvesting and wood fibre consumption volumes for a three-year period in the late 90s. They also asked licensees to supply the community of residence of their corporate and contractor employees.

The indirect/induced employment coefficients are calculated from BC Government Input/Oubut Model industry ratios. A consultant to BC Stats, a branch of the BC Ministry of Finance and Corporate Relations, has prepared economic base multipliers for all TSAs[1].

Forest sector employment income was estimated using Statistics Canada 2001 Census data. Annual employment income for a full-time worker in harvesting is estimated to be $44 642 and $42 555 in wood manufacturing. Indirect employment income is obtained by multiplying the estimated indirect employment by an average annual income of $31 889.

Qualifications

The quality of an analysis is a function of the skills of the analysts and the time and resources provided to undertake it. This assessment is intended to provide a broad understanding of fundamental economic and social issues and to stimulate reflection and discussion. It is based on recent historical experience and is undertaken by experienced analysts using widely accepted methods.

The foundation for the forestry related projections is the employment per thousand cubic metres of harvested and processed timber. This historical relationship is assumed in the projections not to vary over the long-term planning horizon of this study. This assumption produces a linear relationship. The many factors that influence this relationship, however, including technology, input costs, and timber prices, will be different tomorrow. No attempt is made herein to forecast or predict changes in these variables or to include related sensitivity analyses.

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[1] And can be interpreted as a subset of the province-wide multipliers. How much of the indirect and induced economic activity that is generated by direct economic activity in a region depends on the size and complexity of the region's economy. Lower Mainland indirect and induced multipliers will be much higher than those for the Lillooet TSA because the former is a metropolitan economy and the latter is a resource-based economy that has a much lower level of business services and retail activity.

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